UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

MAR 11 2002

In Reply Refer To:
SWR-00-SA-5904:MET

Mr. Michael J. Ryan, Area Manager
Bureau of Reclamation
Northern California Area Office
16349 Shasta Dam Blvd.
Shasta Lake, California 96019-8400

Colonel Michael J. Walsh
District Engineer, Sacramento District
U.S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814-2922

Dear Mr. Ryan and Colonel Walsh:

Please find enclosed the National Marine Fisheries Service's (NMFS) final biological opinion concerning the effects of lower Stony Creek water management operations on the endangered Sacramento River winter-run chinook salmon (*Oncorhynchus tshawtscha*), threatened Central Valley spring-run chinook salmon (*O. tshawtscha*), the Central Valley steelhead (*O. mykiss*) and their respective designated critical habitats.

The biological opinion concludes that the proposed action is not likely to jeopardize the continued existence of the above listed species, nor will it result in the adverse modification of their respective critical habitats. Because NMFS believes there is the likelihood of incidental take of listed species as a result of the proposed water management operations, an incidental take statement is also attached to the biological opinion. This take statement includes reasonable and prudent measures that NMFS believes are necessary and appropriate to reduce, minimize, and monitor project impacts. Terms and conditions to implement the reasonable and prudent measures are presented in the take statement and must be adhered to in order for take incidental to this project to be authorized.

The total time period to be covered under this biological opinion shall not exceed three years from the date of its issuance. At that time all provisions of this biological opinion shall expire, including any coverage for incidental take. The U.S. Army Corps of Engineers and Bureau of Reclamation (Reclamation) will then be required to reinitiate formal consultation on the effects of lower Stony Creek water management operations on any species which may be listed at that time. The reason for the establishment of this time limit is that several important studies are currently, or soon will be, underway which will provide extensive new information on the impacts and potential solutions to those impacts associated with lower Stony Creek water management operations. The studies which are expected to provide this important information include the fisheries monitoring study proposed by Reclamation, the fish passage/water supply study underway at Red Bluff Diversion Dam, the feasibility study for the Orland Project distribution system rehabilitation project and the Stony Creek water supply and flood risk analysis called for in the terms and conditions of the attached incidental take statement.

In addition, NMFS has evaluated the proposed action for potential adverse effects to Essential Fish Habitat (EFH) pursuant to Section 305(b)(2) of the Magnuson-Stevens Fisheries Conservation and Management Act (MSFCMA) (Enclosure 2). Recent amendments to the MSFCMA require federal agencies to consult with NMFS regarding any action or proposed action that may adversely affect EFH for federally managed fish species. The project site includes areas identified as EFH for various life stages of salmon species federally managed under the Pacific Coast Salmon Fishery Management Plan (chinook salmon). Based on the best available information, NMFS has determined that the proposed action may adversely affect EFH. For more information on EFH, see our website at http://swr.nmfs.noaa.gov .

We appreciate your continued cooperation in the conservation of listed species and their habitat, and look forward to working with you and your staff in the future. If you have any questions regarding this document, please contact Mr. Michael Tucker in our Sacramento Area Office, 650 Capitol Mall, Suite 8-300, Sacramento, CA 95814. Mr. Tucker may be reached by telephone at (916) 930-3604 or by Fax at (916) 930-3629.

Sincerely,

for Rodney R. McInnis
Acting Regional Administrator

cc: NMFS-PRD, Long Beach, CA
Stephen A. Meyer, ASAC, NMFS, Sacramento, CA
Max Stodolski, Reclamation, Red Bluff, CA
Rick Massa, OUWUA, Orland, CA
Art Bullock, TCCA, Willows, CA

Enclosure 1

BIOLOGICAL OPINION

Agencies: U.S. Bureau of Reclamation and U.S. Army Corps of Engineers

Activity: Lower Stony Creek Water Management

Consultation Conducted By: Southwest Region, National Marine Fisheries Service.

Date Issued: MAR 11 2002

BACKGROUND AND CONSULTATION HISTORY

In a letter dated May 18, 1999, the U.S. Bureau of Reclamation (Reclamation) requested initiation of informal Section 7 consultation with the National Marine Fisheries Service (NMFS) on a proposed fisheries monitoring study to be conducted on Stony Creek for the purpose of determining potential water management strategies for the protection and enhancement of fisheries resources on the creek. In a reply to that letter dated September 7, 1999, NMFS informed Reclamation that because the study plan included sampling of listed salmonids, the intentional "direct take" of those species would need to be authorized by the issuance of a research permit under Section 10(a)(1)(A) of the Endangered Species Act (Act).

In a reply letter dated November 8, 1999, Reclamation requested a Section 10(a)(1)(A) research permit for the proposed Stony Creek fisheries monitoring study. A short time later in a letter dated February 7, 2000, Reclamation also requested the initiation of informal consultation on the annual operation of the Constant Head Orifice (CHO) which diverts water from Stony Creek into the Tehama Colusa Canal (TCC). NMFS reply to these letters was sent out on March 15, 2000, in which we recommended that a comprehensive formal consultation combining all water management operations on Stony Creek, as well as the fisheries monitoring study, be conducted between Reclamation, the Army Corps of Engineers (Corps), and NMFS. The Corps was included in the consultation process because they control releases from Black Butte Reservoir during flood control operations.

A series of meetings were held on May 11 and June 7, 2000, as well as several telephone conversations and e-mail exchanges, to discuss the scope and guidelines for a comprehensive consultation on Stony Creek water management operations. Additionally, a first draft of a biological assessment was prepared and distributed by Reclamation prior to the June 11 meeting. Parties in attendance at these meetings included NMFS, Reclamation, The Tehama Colusa Canal Authority (TCCA), the Orland Unit Water Users Association (OUWUA), the Corps and the California Department of Fish and Game (DFG).

Following another series of correspondences including a meeting on September 11, 2000, a final biological assessment was jointly submitted to NMFS by Reclamation and the Corps on December 12, 2000. After formal consultation was initiated, several more meetings were held on January 29, February 12, and June 6, 2001 to exchange information and discuss certain aspects of the forthcoming biological opinion. Additional biological and hydrological information was provided to NMFS by Reclamation and the Corps on February 6, and June 19, 2001 respectively. Two letters requesting time extensions for the consultation process were submitted by NMFS to Reclamation and the Corps on April 16, and July 24, 2001. The final request was to extend the due date for the biological opinion to September 7, 2001. A draft biological opinion for the proposed action was issued to Reclamation and the Corps on November 7, 2001. Comments on the draft biological opinion were received from Reclamation on January 31, 2002 and the Corps on February 5, 2002. A complete administrative record for this consultation is available at the NMFS Southwest Region Sacramento Field Office.

DESCRIPTION OF THE PROPOSED ACTION

Reclamation and the Corps are proposing to continue to manage the water resources of the Stony Creek watershed by controlling the release of flows from Black Butte Reservoir (in coordination with upstream reservoir operations) for the purposes of flood control, water delivery for agricultural use, recreation and natural resource management. The Black Butte Project was authorized by Congress as part of the comprehensive plan of development for the Sacramento River Watershed under the Flood Control Act of 1944. Black Butte Dam and Lake were constructed by the COE in 1963. According to Public Law (P.L.) 91-502, October 23, 1970 (84 Stat.1097), Black Butte was financially integrated and operationally coordinated with the Central Valley Project (CVP) by Reclamation.

The COE proposes to continue operating Black Butte Dam during flood control season in accordance with the Water Control Plan and Flood Control Diagram as it has since 1963. This involves managing releases from Black Butte Reservoir into lower Stony Creek so as to maintain control over flood waters captured by the reservoir in accordance with the guidelines set forth in the Black Butte Water Control Plan and Flood Control Diagram.

Reclamation proposes to continue operating Black Butte Dam, during periods outside of flood control operations, for water conservation storage and to supply water for: irrigation, maintenance of a minimum release of 30 cfs into lower Stony Creek, and management of Black Butte Lake for crappie spawning in accordance with the SWRCB permit #13776. As part of their water delivery operations, Reclamation holds contracts with the TCCA and OUWUA for delivery of water from Stony Creek. Water delivered to TCCA is diverted out of lower Stony Creek at the point where the creek passes over the Tehama Colusa Canal. According to the SWRCB permit #13776, the TCCA can only receive Stony Creek's Central Valley Project water if available, during the operation season of April 1 through May 15 and September 15 through October 29, for an annual maximum of 38,293 acre-feet.

OUWUA operates Stony Gorge and East Park Reservoirs on upper Stony Creek which were built in the early 1900's as part of the Orland Project. An Exchange Agreement (contract #14-06-200-1020A) was implemented between Reclamation and the OUWUA in 1964. This agreement allows the exchange of Orland Project water in Black Butte with Stony Gorge and East Park Reservoirs. Water delivered to OUWUA through this exchange agreement is diverted at two points on lower Stony Creek, one at the base of Black Butte Dam and one at the North Diversion Dam. Reclamation retains ownership of the Orland Project facilities, however the facilities have been operated since 1954 by the OUWUA under contract #14-06-200-3502 dated August 26, 1954.

In addition to Reclamation's ongoing operations, and in accordance with recommendations identified in the recently completed Lower Stony Creek Fish, Wildlife and Water Use Management Plan (November 13, 1998), Reclamation has proposed initiating and funding a three-year fisheries monitoring program to begin in the Fall of 2000 or as soon as practicable. The program began in January 2001, but intensive fish collection activities can not begin until this opinion is finalized and incidental take is authorized.

Delineation and Description of the Action Area

The projects and specific facilities associated with Stony Creek water management operations are the Orland Project (East Park Dam and Reservoir; Stony Gorge Dam and Reservoir; Rainbow Diversion Dam and East Park Feeder Canal; South Diversion Intake and South Canal; and Northside Diversion Dam and the North Canal), Black Butte Project (Black Butte Dam, Lake and Powerplant), and the Central Valley Project (Black Butte Lake storage; and the Tehama Colusa Canal with associated Constant Head Orifice).

The action area for this project includes the active stream channels and riparian corridors of Stony Creek and Little Stony Creek below Rainbow Diversion Dam and East Park Reservoir respectively (See Figure 1). Although the listed salmonids addressed in this opinion have long been excluded from the upper watershed above Black Butte Dam, discretionary actions taken during standard operations of the impoundments and facilities in the upper watershed have direct impacts on the timing and magnitude of flows and other habitat conditions in the lower creek. These areas must be considered as part of the action area.

The Stony Creek Watershed encompasses approximately 780 square miles from the crest of the Coastal Range to the confluence of Stony Creek and the Sacramento River near Hamilton City, including portions of Tehama, Glenn, Lake, and Colusa Counties. Starting at the confluence of the Sacramento River or creek mile (CM) 0, Stony Creek extends to Black Butte Lake at CM 24.6 which is the current upper limit of access for anadromous fish. Above Black Butte Lake the creek continues up to Stony Gorge Reservoir at CM 46, intersects with Little Stony Creek at approximately CM 62, and continues to the headwaters at approximately CM 90. Little Stony Creek extends approximately two miles from Big Stony Creek upstream to East Park Reservoir. Major tributaries in the watershed include Little Stony Creek which is impounded by East Park Dam; Grindstone Creek, which enters Stony Creek midway between Stony Gorge Dam and Black Butte Lake; and the North, South and Middle Forks of Stony Creek which join together to

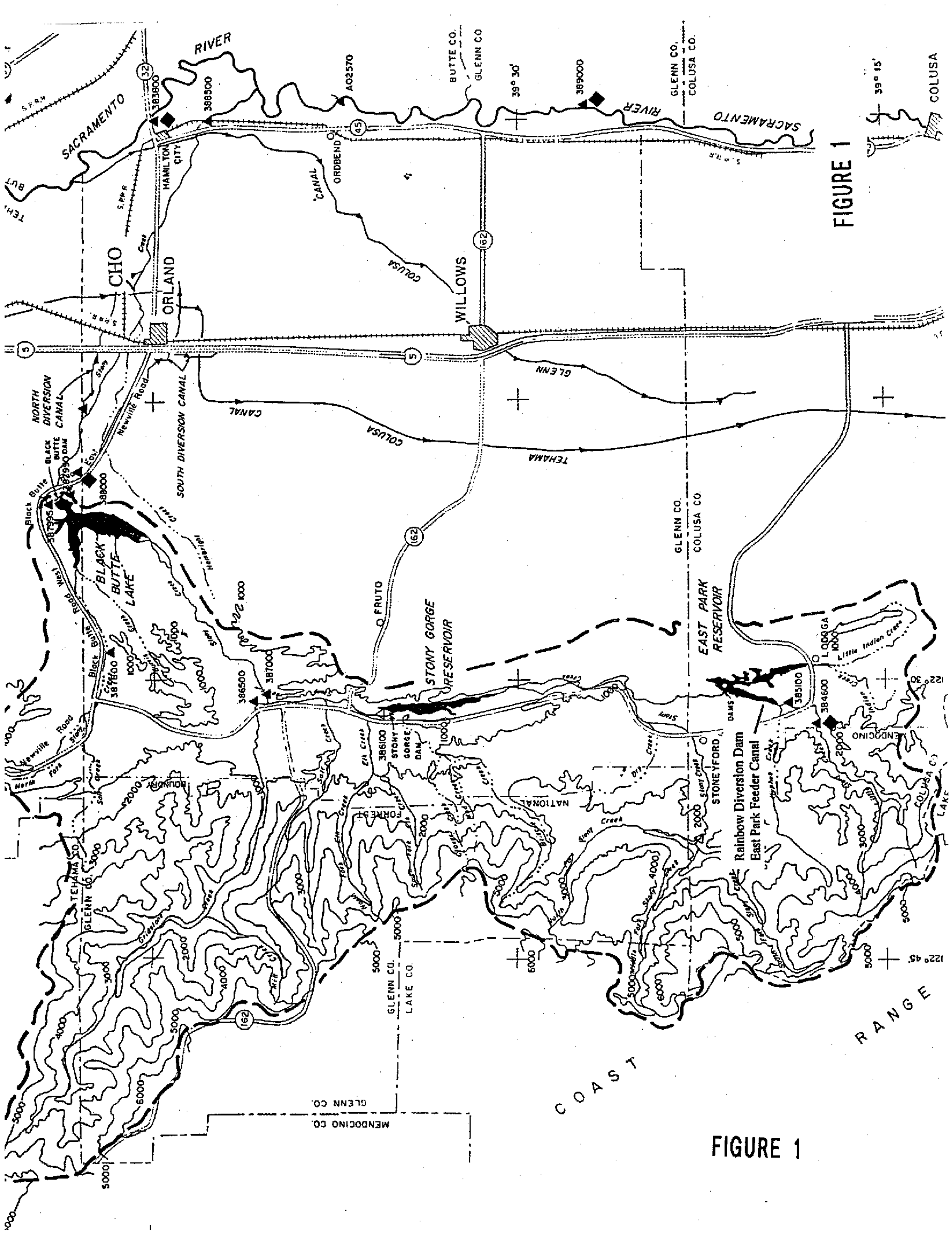
SACRAMENTO
RIVER
HAMILTON CITY
ORDBEND
CANAL
COLUSA
ORLAND
WILLOWS
NORTH DIVERSION CANAL
SOUTH DIVERSION CANAL
Newville Road
BLACK BUTTE DAM
BLACK BUTTE LAKE
GLENN
TEHAMA
FRUTO
STONY GORGE RESERVOIR
STONY GORGE DAM
EAST PARK RESERVOIR
STONEYFORD
LODOGA
Rainbow Diversion Dam
East Park Feeder Canal
NATIONAL FORREST
BOUNDARY
GLENN CO.
COLUSA CO.
BUTTE CO.
TEHAMA CO.
LAKE CO.
MENDOCINO CO.
COAST RANGE
383800
388500
A02570
389000
387995
388000
387800
386500
387000
386100
385100
384600
39° 30'
39° 15'
122° 30'
122° 45'
COLUSA
FIGURE 1

FIGURE 1

create the main stem of Stony Creek just north of Fouts Springs. The operations of East Park, Stony Gorge, and Black Butte Dams are interrelated.

Lower Stony Creek is described as that portion of Stony Creek which flows from Black Butte Dam to the Sacramento River, a distance of 24.6 miles. Lower Stony Creek is the second largest tributary on the western side of the Central Valley in northern California and is located within Tehama and Glenn Counties.

Laws, Directives and Orders

Orland Project.
The Orland Project was authorized by the Secretary of Interior in October 1907. The Orland Project Plan provides for water storage in East Park and Stony Gorge Reservoirs. East Park and Stony Gorge Reservoirs were completed in 1910 and 1928, respectively.

Black Butte Project.
The Black Butte Project was authorized by Congress as part of the comprehensive plan of development for the Sacramento River Watershed under the Flood Control Act of 1944. Black Butte Dam and Lake were constructed by the COE by 1963. According to Public Law (P.L.) 91-502, October 23, 1970 (84 Stat.1097), Black Butte was financially integrated and operationally coordinated with the Central Valley Project (CVP) by Reclamation.

CVP
The CVP was originally conceived as a State project to protect the Central Valley from water shortages and floods in the 1930's. In the depression era, the State was unable to finance the project and the water development was accomplished by the federal CVP, beginning with its authorization in 1935. Reclamation holds water diversion permit #13776 from the State Water Resources Control Board (SWRCB), which was originally issued to Reclamation in November of 1962 to divert and store water in Black Butte Lake. The permit was amended in 1996 to include an additional point of rediversion at the Tehama Colusa Canal (TCC) through the Constant Head Orifice (CHO), using diverted CVP water out of Black Butte Lake into Stony Creek, then into the TCC to supplement their irrigation water deliveries.

Rivers and Harbors Act
The Rivers and Harbors Act (1935, 1937, 1940) first authorized the CVP for construction and included a provision that dams and reservoirs were to be used first for rivers' regulation, improvement of navigation, and flood control; second for irrigation and domestic uses; and third for power.

Description of the proposed action

Orland Project
The Orland Project includes facilities to store and regulate water in Stony Creek for irrigation. Additional beneficial uses from the project include recreation, and fish and wildlife habitat enhancement. The main facilities of the Orland Project include East Park Dam and Reservoir

(51,000 acre-feet storage capacity); Stony Gorge Dam and Reservoir (50,300 acre-feet storage capacity); Rainbow Diversion Dam/East Park Feeder Canal; South Diversion Intake/South Canal; and Northside Diversion Dam/North Canal. The South and Northside Diversions supply water to almost 17 miles of canals and 139 miles of laterals.

East Park Dam is located on Little Stony Creek approximately 2 miles from the confluence with Stony Creek (CM 62). East Park Reservoir extends 2 1/4 miles up Little Stony Creek and 4 ½ miles up Indian Creek. Except for a gently rolling valley above the reservoir, the drainage basin for East Park Dam is hilly and mountainous, ranging in elevation from 1,200 feet to 6,000 feet. Runoff from Little Stony Creek watershed provides water to the reservoir. East Park Reservoir also receives inflows from the East Park Feeder Canal which diverts water from Stony Creek at the Rainbow Diversion Dam (approximately CM 65). The East Park Feeder Canal is 7 miles long and has a design capacity of 300 cfs. The canal provides water from the main stem of Stony Creek into East Park. Releases and spills from East Park Reservoir flow down Stony Creek 18 miles for re-storage in Stony Gorge Reservoir.

OUWUA proposes to operate the East Park Dam based on demand according to the following standard operational procedures. Storage in East Park Reservoir will be maintained as close to the maximum level as possible and water levels will be kept stable until at least June 1 of each year, unless irrigation demands necessitate releases. When necessary, East Park Reservoir storage will be released for irrigation to the minimum storage of 5,000 acre-feet. In the last decade, East Park Reservoir has been maintained close to the maximum storage for 8 of 10 years. Due to the limited sources of inflow within the upper watershed, releases for irrigation from East Park Reservoir, if they occur at all, typically occur after June 1 and only after much of the storage in the downstream reservoirs has been depleted. The 1964 Exchange Agreement allows Orland Project water held in East Park Reservoir to be exchanged with CVP water in Black Butte Lake; releases of Orland Project water are then made from Black Butte Lake storage instead of from East Park Reservoir.

OUWUA proposes to operate the Rainbow Diversion Dam and the East Park Feeder Canal on an as-needed basis to provide supplemental water to East Park Reservoir.

Stony Gorge Dam is located at CM 46. Stony Gorge Reservoir regulates flows along the middle reaches of Stony Creek and stores surplus water for irrigation purposes. Releases from the reservoir travel 22 to 26 miles down Stony Creek to the Orland Project's diversion points at Black Butte Dam (South Diversion Intake/South Canal) and the Northside Diversion Dam/North Canal, respectively.

OUWUA proposes to operate the Stony Gorge Dam based on demand according to the following standard operational procedures. Winter storage at Stony Gorge is restricted to 38,311 acre-feet (10 feet below the full storage capacity) in order to provide a buffer to prevent overtopping of the dam during extreme high flow events. Operating procedures state that Stony Gorge has no flood storage and is therefore operated to pass all high flows above the maximum winter elevation of 831 feet. Spilling above the 831-foot level continues until approximately the end of February depending upon the long-range forecast. Storage in Stony

Gorge Reservoir will be maintained as close to the maximum allowable storage level as possible, unless irrigation demands necessitate releases. When necessary, Stony Gorge Reservoir storage can be released for irrigation to the minimum storage of 7,500 acre-feet. The 1964 Exchange Agreement allows Orland Project water held in Stony Gorge Reservoir to be exchanged with CVP water within Black Butte; releases of Orland Project water are then made from Black Butte storage instead of from Stony Gorge. Water left in Stony Gorge Reservoir early in the season is available for releases into lower Stony Creek later in the summer or early fall.

South Diversion Intake and South Canal were built in conjunction with Black Butte Dam in 1963. Water from Black Butte Dam is released into a 5-10 acre afterbay before it is either diverted into the South Diversion Intake structure or allowed to flow downstream into lower Stony Creek. The South Diversion Intake is located approximately 300 yards downstream and southeast of Black Butte Dam and at the southern end of the afterbay. Afterbay waters flow by gravity into the headworks of the South Canal. Orland Project water can originate from several sources including: (1) water released from storage directly from East Park or Stony Gorge Reservoirs, (2) water stored in East Park or Stony Gorge Reservoirs that is exchanged with CVP water stored in Black Butte, or (3) water resulting from available natural inflows.

The maximum design capacity of the South Canal inlet structure is 530 cfs, however the maximum operating capacity is 250 cfs between Black Butte Dam and Interstate 5 (I-5). Below I-5, the capacity is reduced to 200 cfs, and further reduced to 80 cfs in Lateral 40.

OUWUA proposes to operate the South Diversion Intake and South Canal based on demand for the life of the Orland Project according to the following standard operational procedures. Diversions will typically occur during the months of March to November. Year-round operation may occur dependent on water demands and weather patterns. In conjunction with the terms of the Exchange Agreement, diversions into the South Diversion Canal may result in reductions of Black Butte storage, reducing the amount of water available for release down lower Stony Creek

Northside Diversion Dam and North Canal were completed in 1913 and are located on Stony Creek approximately four miles below Black Butte Dam. As constructed, the Northside Diversion Dam (NDD) consists of a low concrete weir rising approximately ten feet above the base streambed level, on top of which metal jacks and wooden flashboards are installed to impound water during the irrigation season. The weir is 375-feet long, trapezoidal, and situated on a clay base. There is an associated concrete apron on the downstream side of the weir that is approximately 20-feet wide along the entire length of the weir. The north end of the diversion dam structure contains a 36-foot sluiceway which contains a 12-foot long by 6-foot wide, electronically operated drum gate that allows water to be bypassed downstream during diversions into the North Canal. The North Canal headworks is also located on the north side of the dam and is approximately 10-feet wide with two mechanically operated metal gates placed within a concrete frame. The North Canal intake has a maximum design capacity of 150 cfs, however the maximum operating capacity is 130 cfs.

When the flashboards are placed into the diversion dam structure, water from lower Stony Creek is diverted into the North Canal headworks up to a maximum of 130 cfs with an associated minimum bypass of 30 cfs. When water is no longer needed for irrigation or when flood control criteria are triggered, the flashboards are removed to allow Black Butte releases to flow downstream unimpeded. Typically, flashboards are installed in the spring and removed in the fall. However, it may occur that the flashboards are installed and removed several times during the year due to major flood control releases (i.e., boards were installed/removed three times in the spring of 1998 with the heavy rainfall and flows). If Black Butte is in flood control stage during the irrigation season, the OUWUA is notified by Reclamation prior to major releases (>1500 cfs) and the flashboards are removed to prevent damage to the dam structure. The boards are re-installed if there is continued demand for irrigation water. If the irrigation demand is 35 cfs or less, diversion can occur without installing the boards. It typically takes 7-8 people approximately 4-5 hours to install and remove the flashboards. During placement and removal, flows in the creek must be limited to a maximum of 30 cfs for approximately 24 hours for workers to safely access flashboards.

Reclamation retains ownership of the Orland Project facilities, however the facilities have been operated since 1954 by the OUWUA under contract #14-06-200-3502 dated August 26, 1954. An Exchange Agreement (contract #14-06-200-1020A) was implemented between Reclamation and the OUWUA in 1964. This agreement allows the exchange of Orland Project water in Black Butte with Stony Gorge and East Park Reservoirs. As a result of the 1964 Exchange Agreement minimum reservoir storage during the non-flood control season was established for East Park (5,000 acre-feet to protect the fisheries), Stony Gorge Reservoir (5,000 acre-feet, subsequently amended to 7,500 acre-feet, to protect the fisheries and provide municipal water supplies to Elk Creek and water users along Stony Creek), and Black Butte (20,000 acre-feet to protect the fisheries). East Park Reservoir is the most difficult of the three Stony Creek reservoirs to fill and carryover storage left in East Park Reservoir at the end of the irrigation season is normally retained.

Memorandum of Understanding (MOU).

In 1971, Reclamation, the COE, DFG and OUWUA entered into a MOU and set forth a document entitled "General Operating Objectives Stony Creek Reservoirs." The objective of the MOU is to provide stable water levels during a three week period in late spring for the maintenance of crappie spawning habitat in Stony Gorge Reservoir (odd years) and Black Butte Lake (even years). The guidelines state that when water surface temperatures reach 60°F in the spring, all agencies will endeavor to limit reservoir elevation fluctuations to within plus or minus two feet for three weeks. In order to accomplish this, a water exchange is made with OUWUA to maintain the 2-foot criteria in Black Butte Lake. Under normal operating conditions, Stony Gorge Reservoir elevation in most years remains within the 2-foot criteria and requires minimal manipulation to get through the spawning period. This MOU has subsequently been adopted and revised within the State Water Resource Control Board permit #13776 to state that the period for stable water levels be increased from three weeks to four-to-five weeks.

Bypass and Release Flows.
During diversions into the North Canal, an operational bypass of 30 cfs flows into lower Stony Creek by informal agreement between Reclamation, DFG and the OUWUA. The Orland Project is entitled to a natural flow not to exceed 279 cfs (or 553 acre-feet per day) which is typically taken first if available, plus a maximum of 102,000 acre-feet per year of storage water, if available.

Tricolored Blackbirds.
East Park Reservoir provides one of the few nesting habitats for California's endemic tricolored blackbird, a species of special concern that is declining in numbers. Tricolored blackbirds settle during April and May and nesting within the cattails and rushes along the margins of the reservoir is completed by the end of June. Lowering East Park Reservoir's water level before these birds settle will preclude their settlement (Hamilton 1997). DFG has recommended that water levels at East Park be maintained at peak levels until June 1, or until the last tricolored blackbirds have fledged. Under normal operating conditions, East Park Reservoir elevations have remained at maximum levels under the Exchange Agreement, and peak levels have usually been maintained until June 1.

Ongoing and Future Operations
The OUWUA has recently initiated a major effort to rehabilitate its entire distribution system below Black Butte Reservoir. The main goal of this project is to improve water conveyance and on-farm efficiency throughout the OUWUA service area. The proposed plan includes the consolidation of diversion points such that all OUWUA water would be taken from the base of Black Butte Dam and there would be no further need for on-stream diversions (i.e. the NDD diversion point would be abandoned and the dam removed). Additional improvements to the system would include conversion of up to 40 miles of canals and 100 miles of laterals from open channels to piped systems producing substantial water conservation benefits. As a first step in this process OUWUA has received partial funding ($200,000) for a feasibility study of the plan. This feasibility study is expected to be completed within the next two years. If the results of the feasibility study are favorable for implementation of the project, OUWUA plans to apply for further funding for engineering/design and construction. The projected time frame for completion of the project, if all goes well, is approximately eight to ten years.

Until this rehabilitation project is implemented (if it is implemented), OUWUA proposes to continue diversions into the North and South Canals based on water demands and to continue coordinating operations of East Park, Stony Gorge, and Black Butte Dams with Reclamation according to the 1964 Exchange Agreement and the 1971 MOU, with a minimum 30 cfs bypass below the North Canal during diversion activities. Diversions for the Orland Project will typically occur between March and November, however, diversions for irrigation purposes can occur in every month of the year, depending on weather patterns and demand. Based on past operations, annual diversions can be expected to range from 73,900 to 104,824 acre-feet/year although the only restrictions on amounts of irrigation water used are available natural flow not to exceed 279 cfs plus a maximum of 102,000 acre-feet/year of storage from the upper reservoirs, if available.

As described above, flashboards will be installed at the North Diversions dam prior to diversion at the North Canal, and will be removed after irrigation demands no longer exist. If flood release flows in excess of 1500 cfs are called for, Reclamation will notify the OUWUA and allow them the opportunity to remove the flashboards to protect the dam structure. For safety purposes, it is necessary to reduce flows from Black Butte Dam to 30 cfs for 24 hours during the removal of the boards. Once the boards are removed, the flood releases will commence. Upon completion of flood control releases, flashboards may be reinstalled if there are continued irrigation demands, requiring another 24 hour period of 30 cfs flows for reinstallation.

Black Butte Project

Black Butte Dam and Lake

The Black Butte Project was authorized for flood control, irrigation, water supply, and recreation. The main facilities are Black Butte Dam, Lake and Powerplant. In addition, an Orland Project facility known as the South Diversion Intake was included in the design.

In the Flood Control Act, a Black Butte capacity of 160,000 acre-feet was recommended. Since construction, the lake capacity was modified to conform to the area-capacity tables developed in 1978 from 1977 aerial mapping. Because of sedimentation, the capacity at Black Butte at gross pool has been reduced from 160,000 acre-feet to 143,700 acre-feet, and the maximum flood control reservation reduced from 150,000 acre-feet to 137,000 acre- feet per 1977 figures. The project is now operated assuming there is only 143,700 acre-feet of total storage available for all purposes. However, this amount is expected to be reduced to approximately 136,200 acre-feet within the near future as soon as revisions to the COE 1987 Water Control Manual (Corps 1987) are completed. In this manual, the COE will update the amount of total storage available for all purposes based on studies conducted by the COE in 1977 which indicate that sedimentation has reduced the gross pool to approximately 136,200 acre-feet.

Powerplant

Hydroelectric power generation was not a Black Butte Project purpose, however, a run-of-the-river hydroelectric power facility was added to the dam in 1988 by the City of Santa Clara. The powerplant is located approximately 150 yards downstream of Black Butte Dam, and did not come into full operation until 1997. As part of the powerplant construction, a weir was built across the Stony Creek channel approximately 300 yards downstream of Black Butte Dam forming a large shallow afterbay above it. Flows are diverted from this afterbay into the South Canal Diversion intake, when needed for irrigation. A minimum 30 cfs bypass into the creek is maintained.

The powerplant needs a minimum of 200 cfs to turn the turbines, with an operational maximum of 800 cfs and a design maximum of 1000 cfs. The powerplant diverts up to the first 1000 cfs that is released for downstream appropriation or flood control operations. Water that is diverted for hydropower is returned to the afterbay below the dam and continues downstream into lower Stony Creek. When releases from Black Butte exceed 1,000 cfs, the first available 1,000 cfs normally flows through the powerplant and the excess through the COE service gates in the outlet works.

Facilities

The COE retains ownership of the Black Butte Project facilities except for the Orland South Canal Diversion Intake. Black Butte Dam operations for flood control releases are determined by the COE. Reclamation determines irrigation releases during the irrigation season which typically occurs from March to November, but can occur during any month of the year. Operations of the facilities are coordinated between the COE and Reclamation as established under P.L. 91-502 (1970). Although Black Butte Dam is owned by the COE, authorizing legislation did not identify an agency responsible for maintaining the channel capacity of Stony Creek below Black Butte Dam.

CVP Integration

The Black Butte Project was financially and operationally integrated with the other storage features of the CVP in 1970 (P.L. 91-502, 84 Stat. 1097). As a result, Black Butte now provides the maximum practicable amount of storage for conservation of irrigation water without impairment of the flood control functions. Water conserved by Black Butte is authorized to be used for irrigation purposes and to meet such domestic, municipal, and industrial demands as may occur. The estimated conservation yield of Black Butte was 59,000 acre-feet. On the average, it was estimated that 10,600 acre-feet of water would be made available for use in the watershed area above Black Butte and an additional 48,600 acre-feet average annual yield would be available below the dam.

Releases are determined by the needs of the downstream water users during the irrigation season through Reclamation, and by flood control parameters during the flood control season through the COE. The major downstream water users are the OUWUA authorized through the Orland Project and the CVP contractor districts served through the CVP facilities operated by the Tehama Colusa Canal Authority (TCCA).

Flood Control Diagram

Since 1962 the COE, Sacramento District, has operated Black Butte Project for flood control in accordance with the Flood Control Diagram of the Water Control Manual. Flood control reservation, or space, in Black Butte Lake increases linearly from zero on September 1 to a maximum of 136,200 acre-feet (encroachment stage) by November 30, according to the watershed wetness index (PAR). A minimum flood reservation pool of 106,400 acre-feet is required from November 10 to January 23, regardless of the watershed wetness index. The flood reservation is then reduced to zero (reservoir fills) by no later than June 15.

The maximum scheduled flood control release from Black Butte Dam is 15,000 cfs depending on a release schedule that correlates peak inflow for a specific event and the percentage of the flood control storage reserve in use. The controlled capacity through the outlet works is 22,800 cfs. The rated spillway capacity (uncontrolled weir) for the dam is 76,600 cfs. Flood control operations by the COE begin when the storage in Black Butte Lake exceeds the flood control space required at any particular time as determine by the Flood Control Diagram.

According to the Flood Control Diagram, "required gross flood control reservation in Black Butte may be reduced by creditable flood control space known to exist in East Park and Stony Gorge Reservoirs. The flood control requirement in Black Butte Lake is equal to the gross flood control reservation minus the total creditable transfer space."

Operations Forecasting
The California Nevada River Forecast Center provides the COE 6-hour inflow forecasts for the Black Butte Project during severe weather. These forecasts extend 72 hours into the future. The National Weather Service provides the COE 6-hour Quantitative Precipitation Forecasts for the Stony Creek Basin. Even though the COE Water Control Plan does not currently require using forecasted data to operate the projects, these forecasts are used in the COE models and to operate the project. If forecasts show little future rain, the flood space may be evacuated at a slower rate. If the opposite is forecasted, releases may be increased to more quickly evacuate for flood space. It is the COE's intention to formally incorporate forecasting into the Water Control Plan in the near future.

Ongoing and Future Operations
The COE proposes to continue operating Black Butte Dam in accordance with the Water Control Plan and Flood Control Diagram as it has since 1963. The COE is in the process of rewriting the Water Control Manual, however, the Water Control Plan and Diagram are not being changed except to reformat as required by regulation, and to indicate the reduction in total storage that has occurred due to sedimentation. COE inspections or maintenance of the outlet works or powerplant facilities will require some outlet gates to be closed, however, a minimum of 30 cfs flow will be maintained during these outages by keeping at least two gates open. Annual and 5-year inspections will typically occur during mid-November.

Reclamation proposes to continue directing Black Butte Dam operations for water conservation storage and to supply water for irrigation during the irrigation season, maintaining a minimum release of 30 cfs below Black Butte Dam when under its control and managing Black Butte Lake for crappie spawning in accordance with the SWRCB permit #13776. In addition, Reclamation proposes to continue coordinating operations of East Park, Stony Gorge, and Black Butte Dams with the OUWUA according to the 1964 Exchange Agreement; with the OUWUA, COE, and DFG according to the 1971 MOU; and with the COE according to coordinated management.

Central Valley Project

Black Butte Lake Storage
Reclamation directs Black Butte Project operations for water conservation storage and to supply water for irrigation during the irrigation season. The only space allocation made in Black Butte Lake for CVP operations is a 20,000 acre-feet minimum pool storage for recreation and fisheries purposes during flood control periods. Any rainfall and natural inflows into Black Butte Lake that are in excess of what the Orland Project uses are stored as CVP water during non-flood control periods. Available CVP water is defined by Reclamation as excess water during the non-flood period projected to be available for use based on storage

as of June 1 of each year, accounting for required water rights. Factors of evaporative losses, minimum releases, minimum pools, and conditions of the permit are accounted for in the determination of available water. The average annual yield after all accounting is approximately 56,000-59,000 acre-feet.

Tehama Colusa Canal/Constant Head Orifice

The TCC was constructed as part of the CVP facilities in 1965 for the distribution of water diverted from the Sacramento River at the Red Bluff Diversion Dam (RBDD). The TCC and the Corning Canal, which are integral parts of the TCCA canal system, both receive their primary water supply from the RBDD, and are operated and maintained by the TCCA under long term contract with Reclamation. The TCC extends from the RBDD for 111 miles through Tehama, Glenn, and Colusa Counties with its terminus in Yolo County. The originating capacity of the TCC at RBDD is 2,530 cfs reducing to 1,700 cfs at the downstream end.

The TCC, which intersects with lower Stony Creek approximately 30 miles below RBDD, siphons water under Stony Creek. At this crossing, a Constant Head Orifice (CHO) was constructed in 1974 to divert water from the TCC into the creek for fishery enhancement purposes, but this diversion was discontinued in 1975 when a plan to restore Stony Creek's winter-run, fall-run and steelhead spawning habitat was abandoned due to the high cost of stream channel and gravel rehabilitation as well as problems such as land acquisition and access.

Since 1993, the CHO has been used in reverse to divert stored CVP water released from Black Butte into the TCC when the RBDD is not operating. Daily diversions at the CHO have averaged approximately 180 cfs when taken, between 1993 and 2000. Although never rated for a maximum capacity, the CHO capacity has never exceeded 685 cfs. Rediversion operations involve the construction of a gravel berm upstream of the TCC/CHO to direct water into the canal. The berm construction/ rediversion operations have complied with informal consultations since 1993. Bypass culverts are installed to allow a minimum of 40 cfs down Stony Creek during rediversion, as required by the SWRCB permit.

Minimum Instream Flow Requirements

A minimum flow of 30 cfs is required to be released year-round below Black Butte Dam according to Black Butte Project operational objectives and to the *Rediversion of Water to Tehama-Colusa Canal at the Stony Creek Siphon Environmental Assessment* conditions (Reclamation 1995).

SWRCB permit

According to the SWRCB permit #13776, the TCCA can only receive CVP water during the operation season of April 1 through May 15 and September 15 through October 29, for an annual maximum of 38,293 acre-feet. Other flow constraints include (1) maintaining a continuous bypass flow of not less than 40 cfs immediately downstream of the CHO when rediverting, (2) a ramp down rate of no more than 30 percent per hour or 50 cfs, whichever is greater, and (3) to provide a fish distribution flow of not less than 100 cfs for a period of 24 hours prior to rediversion. The intended purpose of this distribution flow is to flush juvenile fish out of the area above the CHO so that they will not become entrained into the diversion.

In addition, a minimum fishery pool of 20,000 acre-feet shall be maintained in Black Butte Lake to the extent that there is not a conflict with prior water rights. In alternate years, Black Butte Lake shall be stabilized for warm water fishery protection; when water temperatures reach 60°F changes in water elevations shall be limited to plus or minus two feet for four to five weeks.

Coordinated Management

In addition to the operating objectives of the 1971 MOU between Reclamation, COE, OUWUA and DFG, and the 1964 Exchange Agreement between Reclamation and the OUWUA for water transfer between East Park, Stony Gorge and Black Butte Reservoirs, Reclamation manages water releases from Black Butte cooperatively with the COE when releases are needed during the flood control season. Reclamation's Willows office and the COE's water management staff communicate daily during the flood control season regarding inflows, predicted precipitation, storage, demand, and other operation issues. When Black Butte water is no longer released for flood control, any water remaining in the lake is considered CVP water.

Ongoing and Future Operations

Reclamation proposes to continue annual rediversions of CVP stored water from Black Butte Dam and delivered via lower Stony Creek into the TCC/CHO until a long-term solution to fish passage and water delivery limitations at the RBDD is reached. Rediversions may occur annually from April 1 to May 15 and September 15 to October 29. A gravel berm will be constructed prior to rediversion in the spring to divert water into the TCC. A minimum bypass flow of 40 cfs will occur during rediversion. As stated in the SWRCB Permit # 13776 (condition 5), steps will be taken to minimize the entrainment of fish through physical and operational efforts, including minimizing flow fluctuations in Stony Creek, and in the rates of rediversion into the TCC. A mean daily fish redistribution flow of not less than 100 cfs for 24 hours prior to the beginning of the rediversion will occur, unless alternate methods are required and agreed upon by Reclamation, SWRCB, DFG, USFWS and NMFS. At this time there has been no maximum rate of diversion set for the CHO although the maximum capacity of the intake structure is estimated to be approximately 1000 cfs and the maximum total rediversion for any one year is 38,293 acre-feet.

Fisheries Monitoring Plan

According to recommendations identified in the recently completed Lower Stony Creek Fish, Wildlife and Water Use Management Plan (November 13, 1998), Reclamation proposes to initiate and fund a three-year fisheries monitoring program scheduled to begin in the Fall of 2000, or as soon as practicable.

The recent construction of a siphon which routs the Glenn-Colusa Irrigation District Canal (GCID) underneath Stony Creek instead of blocking the creek, has resulted in increased opportunities for both upstream and downstream passage of fish. The removal of this barrier has increased the likelihood of salmonid spawning and rearing within areas of lower Stony Creek that are influenced by water management operations. Non-natal salmonid rearing at the mouth of the creek and salmonid use of the lower portions of the creek have been documented (Brown 1995; Maslin and McKinney 1994). One of the objectives within the fisheries monitoring plan is to determine the presence of anadromous fish and their use of available habitats. The information obtained from the monitoring program will assist in management decisions regarding possible water release regime changes to keep fish in good condition, particularly special status salmonid species.

STATUS OF LISTED SPECIES AND DESIGNATED CRITICAL HABITAT

The following listed species and designated critical habitats are likely to be affected by the proposed project:

1. Central Valley spring-run chinook salmon - threatened
2. Central Valley spring-run chinook salmon Critical Habitat
3. Sacramento River winter-run chinook salmon - endangered
4. Central Valley steelhead - threatened
5. Central Valley steelhead Critical Habitat

Sacramento Winter-run Chinook Salmon - Endangered

Status and trends

Although Sacramento winter-run chinook salmon are not expected to spawn in Stony Creek, there is evidence of non-natal rearing of juvenile winter-run in the lower section below Black Butte Reservoir (Maslin and McKinney 1994). Sacramento winter-run chinook salmon inhabiting these areas can be affected by a variety of elements including water quality, quantity and temperature within Stony Creek as well as the quality and quantity of suitable substrate, cover, food and riparian shading.

The Sacramento winter-run chinook salmon were listed as threatened under an emergency rule on August 4, 1989 (54 FR 32085). The final rule listing the Sacramento winter-run chinook salmon as a threatened species under the ESA was published on November 5, 1990 (55 FR 46515). The continued decline of the spawning population, expectations of weak returns in certain years as the result of two depressed year classes, and continuing threats to the population prompted NMFS to reclassify Sacramento winter-run chinook salmon as endangered on January 4, 1994 (59 FR 440).

Prior to construction of Shasta and Keswick dams in 1945 and 1950, respectively, winter-run chinook were reported to spawn in the upper reaches of the Little Sacramento, McCloud, and lower Pit rivers (Moyle et al. 1989). Specific data relative to the historic run sizes of winter-run chinook prior to 1967 are sparse and anecdotal. Numerous fishery researchers have cited Slater (1963) to indicate that the winter-run chinook population may have been fairly small and limited to the spring-fed areas of the McCloud River before the construction of Shasta Dam. However, recent DFG research in California State Archives has cited several fisheries chronicles that indicate the winter-run chinook population may have been much larger than previously thought. According to these qualitative and anecdotal accounts, winter-run chinook reproduced in the McCloud, Pit and Little Sacramento rivers and may have numbered over 200,000 (Rectenwald 1989).

Completion of the Red Bluff Diversion Dam in 1966 enabled accurate estimates of all salmon runs to the upper Sacramento River based on fish counts at the fish ladders. These annual fish counts document the dramatic decline of the winter-run chinook population. The estimated number of winter-run chinook passing the dam from 1967 to 1969 averaged 86,509. During 1990, 1991, 1992, 1993, 1994, 1995, 1996, and 1997 the spawning escapement of winter-run chinook past the dam was estimated at 441, 191, 1180, 341, 189, 1361, 940, and 841 adults (including jacks), respectively.

Hallock and Fisher (1985) identify the following factors that have contributed to the decline of the post-Shasta Dam winter-run chinook salmon: 1) drought, 2) the Red Bluff Diversion Dam, 3) river temperature downstream of Red Bluff, 4) juvenile salmon mortality, and 5) harvest. Two year classes of winter-run were virtually wiped out due to drought conditions in 1976-1977. These year classes have failed to show substantial recovery in subsequent generations. In addition, the strong year class of 1981 failed to return well in 1984, and at present no dominant year class exists. Low fecundity would contribute to the difficulty of recovering from any particular disaster.

All adult chinook salmon which encounter the closed gates at RBDD are likely to be delayed from upstream migration. Delays can range from one day to 40 days at flows between 4,000 and 16,000 cfs (Hallock et al. 1982). Delays reduce reproductive success because migrating adults do not feed but must subsist by catabolizing their body tissues. In 1986 the dam gates at RBDD were raised for a short period to allow free passage of fish through the area. Since that time, the number of months during which the gates are up (free passage) has increased to the current operating conditions which allow free passage from September 15 through May 15 in most years. This operational scenario allows approximately 85% of the adult, upstream migrating winter-run to pass the dam before the gates are closed each spring.

During most years, winter-run salmon are not able to spawn successfully downstream of Red Bluff due to high water temperatures. Water temperatures are determined by releases from upstream dams, limnological dynamics within the reservoirs and to a lesser extent by other environmental conditions such as: solar radiation, air temperatures, riparian shade, accretion volumes and temperatures, depletion or diversions, channel width and depth, wind, humidity, and ground conduction.

Smolt mortality is a major factor affecting winter-run chinook salmon abundance in the Sacramento drainage. Emigrants can be entrained at unscreened or inadequately screened diversions that are operated during the migration period from July through March along the Sacramento River, and from September through June in the Delta. During periods of low net outflow to San Francisco Bay, large numbers of emigrants travel down Georgiana Slough and are lost in the maze of the Delta channels and consequently are subject to entrainment by the SWP and CVP export pumps rather than remaining in the Sacramento River. The SWP and CVP operations also kill, directly and indirectly, many smolts attempting to traverse through the Delta.

Any ocean harvest of winter-run chinook salmon is significant because there are so few of this race remaining that any wild fish caught can affect the population.

Habitat degradation also affects winter-run chinook salmon populations (Hallock and Fisher 1985). They noted the following factors in habitat degradation. There is a loss of spawning habitat upstream of Shasta and Keswick dams because of lack of fish passage facilities and the inundation by the reservoirs of the spawning and rearing areas. There is a lack of gravel recruitment due to sediment trapping behind the dams. This lack is exacerbated by gravel mining activities. The remaining spawning gravel tends to be armored due to controlled flows from the reservoirs and the subsequent reduction of necessary flushing flows. Rip rapping the banks for flood control purposes removes riparian habitat that changes water table relationships and reduces shading on the river. Rip rapping also degrades rearing habitat and increases predation on salmon juveniles.

<u>Life history and habitat requirements</u>
Chinook salmon in the Sacramento River are typically characterized as winter-, spring-, fall-run, or late-fall-run according to the time adults enter freshwater to begin their spawning migration. Accordingly, adult Sacramento winter-run chinook salmon enter freshwater in the winter, but delay spawning until the spring and summer. Juveniles spend approximately five to nine months in the river and estuary systems before entering the ocean. This life history pattern differentiates Sacramento winter-run chinook salmon from other Sacramento River chinook and from all other populations within the range of chinook salmon (Hallock and Fisher 1985).

Pre-emergent fry remain in the redd and absorb the yolk stored in their yolk-sac as they grow into fry. This period of larval incubation lasts approximately 2 to 4 weeks depending on water temperatures (Vogel and Marine 1991). Sacramento River winter-run chinook salmon in the Sacramento River typically emerge from July through October. Emergence typically occurs at night. At the time of emergence from the redd, there is usually an extensive downstream dispersal of fry, although some fry are able to remain within the natal stream and even at the spawning area.

Downstream movement of fry occurs mainly at night, although small numbers of fry move during daylight hours. Night downstream movement is inhibited by bright moonlight (Reimers 1971). Once downstream migration has begun, chinook fry can either continue to migrate down to the estuary or they may stop and rear in the main-stem or tributary streams for a few weeks or even up to a year or more. The fry seek out shallow, nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. As they grow to 50 to 75 mm in length, the juvenile salmon move out into deeper, swifter water, but continue to use available cover to minimize the risk of predation and reduce energy expenditure (Vogel and Marine 1991). The emigration of juvenile chinook may be dependent on streamflow conditions and water year type. Once fry have emerged, storm events may cause en masse emigration pulses.

In large rivers, fry tend to migrate along the margins of the river rather than in the higher velocity water near the center of the channel. When the river is deeper than about 3 meters, they tend to prefer the surface waters (Healey and Jordan 1982). The fry inhabit areas in back eddies, behind fallen trees, undercut tree roots, and other areas of bank cover. As they grow larger, the juveniles tend to move away from shore into midstream and higher velocity areas. Fish size appears to be positively correlated with water velocity and depth (Chapman and Bjornn 1969, Everest and Chapman 1972).

Day and night distributions of chinook juveniles are different. At night, chinook tended towards inshore areas of quiet water over sandy substrates or into pools, where they would settle at the bottom. During daylight hours, the chinook would return to occupy the same riffle or glide areas they had occupied the previous day (Edmundson et al. 1968, Don Chapman Consultants 1989).

Principal foods of chinook while rearing in freshwater and estuarine environments are larval and adult insects and zooplankton such as Cladocerans, Diptera, or Copepoda (Kjelson et al. 1982) of stonefly nymphs or beetle larvae (Chapman and Quistdorff 1938) as well as other estuarine and freshwater invertebrates. Chinook seem to prefer slightly larger organisms and larval and adult insects than other Pacific salmon in the intertidal region of most estuaries.

Juvenile chinook spend three months to two years in freshwater after emergence and before undergoing smoltification. California chinook salmon are primarily 'ocean-type' and tend to use estuaries and coastal areas more extensively than stream-type chinook for rearing. The brackish water areas in estuaries moderate the physiological stress that occurs during parr-smolt transitions. Sacramento winter-run chinook salmon typically migrate to the sea after 5 to 10 months of freshwater residence.

Fry tend to remain in estuarine area until they are about 70 mm in fork length (FL). Ocean entry timing data available for the Central Valley indicate that Sacramento winter-run chinook salmon emigrate to the ocean from November through May (Myers et al. 1998).

Chinook salmon typically remain at sea for two to four years. California chinook salmon are 'ocean-type' and migrate along the coast. Available information on California chinook salmon populations indicates that the fish tend to stay along the California and Oregon coasts.

Adult Sacramento winter-run chinook salmon require water temperatures between 38° and 67° F during upstream migration. When the adults reach spawning areas, they need cold pools to stage in prior to spawning to conserve energy and maintain egg viability as they mature for spawning (Berman and Quinn 1991). Maximum temperatures for holding adults are 59° to 60° F but better egg viability is achieved at 55° to 56° F (Boles et al. 1988).

Chinook salmon spawning generally occurs in swift, relatively shallow riffles or along the edges of fast runs at depths greater than 6 inches, usually 1-3 feet to 10-15 feet. Preferred spawning substrate is clean loose gravel, mostly 0.75-4.0 inch diameter, with no more than 5% fines. Gravels are unsuitable when they have been cemented with clay or fines or when sediments settle out onto redds reducing intergravel percolation. Optimum spawning velocity is 1.5 feet-per-second (fps) but can range from 0.33 - 6.2 fps (Healey 1991).

Minimum intra-gravel percolation rate depends on flow rate, water depth, and water quality. The rate must be adequate to maintain oxygen delivery to the eggs and remove metabolic wastes. Chinook have the largest egg size of the *Oncorhynchus* species and therefore their eggs have a small surface-to-volume ratio (Rounsefell 1957). Chinook eggs are more sensitive to reduced oxygen levels and require a more certain rate of irrigation. The chinook's need for a strong, certain level of subsurface flow may indicate that suitable spawning habitat is more limited in most rivers than superficial observation would suggest. Chinook forced to spawn in areas of low suitability will suffer high rates of egg mortality.

Chinook salmon eggs hatch, depending on water temperatures, between 90 and 150 days after deposition. Sacramento winter-run chinook salmon eggs hatch after 40 to 60 days depending on ambient water temperatures. Stream flow, gravel quality, and silt load all influence the survival of the eggs. Maximum survival of incubating eggs and pre-emergent fry occurs at water temperatures between 42° F and 56° F with a preferred temperature of 52° F. Mortality of eggs and pre-emergent fry commences at 57.5° F and reaches 100 percent at 62° F (Boles 1988). Other potential sources of mortality during the incubation period include redd dewatering, insufficient oxygenation, physical disturbance of the gravel substrate, and water-borne contaminants.

After emergence, most fry disperse downstream, hiding in the gravel or stationing in calm, shallow waters with fine sediments substrate and bank cover such as tree roots, logs, and submerged or overhead vegetation. As they grow, the juveniles associate with coarser substrates along the stream margin or farther from shore (Healey 1991). Optimal temperature ranges for both fry and fingerlings range from 53.6° to 57.2° F with maximum growth rates at 55° F (Boles 1988). Along the emigration route, submerged and overhead cover in the form of rocks, submerged aquatic vegetation, logs, riparian vegetation, and undercut banks provide food, shade and protect juveniles from predation.

Optimal water temperatures for the growth of juvenile chinook salmon in an estuary are 54-57° F (Brett 1952). In Suisun and San Pablo Bays water temperatures reach 54° F by February in most years. Other Delta waters do not reach 54° F until March. The specific cues that trigger juvenile chinook salmon to migrate from the Sacramento-San Joaquin Estuary are not well understood, but water temperatures of 59° F and higher have been observed to induce migration in Northwest estuaries (Dunford 1975, Reimers 1973).

Central Valley Spring-run Chinook Salmon - Threatened

<u>Status and trends</u>

Due to the lack of access to historic spawning and holding habitat, Central Valley spring-run chinook salmon are no longer expected to spawn in Stony Creek, although a single adult chinook salmon was observed at the base of NDD during the second week of June, 2001, which is the time period when spring-run would be expected to be holding in spawning streams (R. Corwin, Reclamation, pers. comm. 2001). There is also documentation of non-natal rearing of juvenile spring-run in the lower section below Black Butte Reservoir (Maslin and McKinney 1994). Central Valley spring-run chinook salmon inhabiting these areas can be affected by a variety of elements including water quality, quantity and temperature within Stony Creek as well as the quality and quantity of suitable substrate, cover, food and riparian shading.

Effective November 16, 1999, NMFS listed Central Valley spring-run chinook salmon as threatened under the Endangered Species Act (64 FR 50394). Historically, spring-run chinook salmon were predominant throughout the Central Valley, occupying the upper and middle reaches of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud, and Pit Rivers, with smaller populations in most other tributaries with sufficient habitat for over-summering adults (Stone 1874, Rutter 1904, Clark 1929). The Central Valley drainage as a whole is estimated to have supported spring-run chinook salmon runs as large as 600,000 fish between the late 1880s and 1940s (DFG 1998). Before the construction of Friant Dam, nearly 50,000 adults were counted in the San Joaquin River (Fry 1961). Following the completion of Friant Dam, the native population from the San Joaquin River and its tributaries was extirpated. Also, spring-run no longer exist in the American River due to Folsom Dam.

Clark (1929) estimated that originally there were 6,000 miles of salmon habitat in the Central Valley system and that 80% of this habitat had been lost by 1928. Yoshiyama et al. (1996) calculated that roughly 2,000 miles of salmon habitat was actually available before dam construction and mining, and concluded that 82% is not accessible today. Clark (1929) did not give details about his calculation. Whether Clark's or Yoshiyama's calculation is used, only remnants of their former range remain accessible today in the Central Valley (DFG 1998).

Impassable dams block access to most of the historical headwater spawning and rearing habitat of Central Valley spring-run chinook salmon. In addition, much of the remaining, accessible spawning and rearing habitat is severely degraded by elevated water temperatures, agricultural and municipal water diversions, unscreened and poorly screen water intakes, restricted and regulated streamflows, levee and bank stabilization, and poor quality and quantity of riparian and shaded riverine aquatic (SRA) cover.

Natural spawning populations of Central Valley spring-run chinook salmon are currently restricted to accessible reaches in the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and Yuba River (DFG 1998; FWS, unpublished data). With the exception of Butte Creek and the Feather River, these populations are relatively small ranging from a few fish to several hundred. Butte Creek returns in 1998 and 1999 numbered approximately 20,000 and 3,600, respectively (DFG unpublished data). On the Feather River, significant numbers of spring-run chinook, as identified by run timing, return to the Feather River Hatchery. However, coded-wire-tag information from these hatchery returns indicates substantial introgression has occurred between fall-run and spring-run chinook populations in the Feather

River due to hatchery practices. Over time, the spring-run within the Feather River may become homogeneous with Feather River fall-run fish unless current hatchery practices are changed.

Life history and habitat requirements

Spring-run chinook salmon adults are estimated to leave the ocean and enter the Sacramento River from March to July (Myers et al. 1998). This run timing is well adapted for gaining access to the upper reaches of river systems, 1,500 to 5,200 feet in elevation, prior to the onset of high water temperatures and low flows that would inhibit access to these areas during the fall. Throughout this upstream migration phase, adults require streamflows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate streamflows are also necessary to allow adult passage to upstream holding habitat in natal tributary streams. The preferred temperature range for spring-run chinook salmon completing their upstream migration is 38° F to 56° F (DFG 1998).

When they enter freshwater, spring-run chinook salmon are immature and they must stage for several months before spawning. Their gonads mature during their summer holding period in freshwater. Over-summering adults require cold-water refuges such as deep pools to conserve energy for gamete production, redd construction, spawning, and redd guarding. The upper limit of the optimal temperature range for adults holding while eggs are maturing is 59° F to 60° F. Unusual stream temperatures during spawning migration and adult holding periods can alter or delay migration timing, accelerate or retard mutations, and increase fish susceptibility to diseases. Sustained water temperatures above 80.6° F are lethal to adults (Cramer and Hammack 1952; DFG 1998).

Adults prefer to hold in deep pools with moderate water velocities and bedrock substrate and avoid cobble, gravel, sand, and especially silt substrate in pools (Sato and Moyle 1989). Optimal water velocities for adult chinook salmon holding pools range between 0.5-1.3 feet-per-second and depths are at least three to ten feet (G. Sato unpublished data, Marcotte 1984). The pools typically have a large bubble curtain at the head, underwater rocky ledges, and shade cover throughout the day (Ekman 1987).

Spawning typically occurs between late-August and early October with a peak in September. Once spawning is completed, adult spring-run chinook salmon die. Spawning typically occurs in gravel beds that are located at the tails of holding pools (USFWS 1995a). Spring-run adults have been observed spawning in water depths of 0.8 feet or more, and water velocities from 1.2-3.5 feet-per-second (Puckett and Hinton 1974). Eggs are deposited within the gravel where incubation, hatching, and subsequent emergence takes place. Optimum substrate for embryos is a mixture of gravel and cobble with a mean diameter of one to four inches with less than 5% fines, which are less than or equal to 0.3 inches in diameter (Reiser and Bjornn 1979). The upper preferred water temperature for spawning adult chinook salmon is 55° F (Chambers 1956) to 57° F (Reiser and Bjornn 1979).

Length of time required for eggs to develop and hatch is dependant on water temperature and is quite variable, however, hatching generally occurs within 40 to 60 days of fertilization (Vogel and Marine 1991). In Deer and Mill creeks, embryos hatch following a 3-5 month incubation period (USFWS 1995). The optimum temperature range for chinook salmon egg incubation is 44° F to 54° F (Rich 1997). Incubating eggs show reduced egg viability and increased mortality at temperatures greater than 58° F and show 100% mortality for temperatures greater than 63° F (Velson 1987). Velson (1987) and Beacham and Murray (1990) found that developing chinook salmon embryos exposed to water temperatures of 35° F or less before the eyed stage experienced 100% mortality (DFG 1998).

After hatching, pre-emergent fry remain in the gravel living on yolk-sac reserves for another two to four weeks until emergence. Timing of emergence within different drainages is strongly influenced by water temperature. Emergence of spring-run chinook typically occurs from November through January in Butte and Big Chico Creeks and from January through March in Mill and Deer Creeks (DFG 1998).

Post-emergent fry seek out shallow, nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. As they grow to 50 to 75 mm in length, the juvenile salmon move out into deeper, swifter water, but continue to use available cover to minimize the risk of predation and reduce energy expenditure. The optimum temperature range for rearing chinook salmon fry is 50° F to 55° F (Boles et al. 1988, Rich 1997, Seymour 1956) and for fingerlings is 55° F to 60° F (Rich 1997).

In Deer and Mill creeks, juvenile spring-run chinook, during most years, spend 9-10 months in the streams, although some may spend as long as 18 months in freshwater. Most of these "yearling" spring-run chinook move downstream in the first high flows of the winter from November through January (USFWS 1995, DFG 1998). In Butte and Big Chico creeks, spring-run chinook juveniles typically exit their natal tributaries soon after emergence during December and January, while some remain throughout the summer and exit the following fall as yearlings. In the Sacramento River and other tributaries, juveniles may begin migrating downstream almost immediately following emergence from the gravel with emigration occurring from December through March (Moyle, et al. 1989, Vogel and Marine 1991). Fry and parr may spend time rearing within riverine and/or estuarine habitats including natal tributaries, the Sacramento River, non-natal tributaries to the Sacramento River, and the Delta. In general, emigrating juveniles that are younger (smaller) reside longer in estuaries such as the Delta (Kjelson et al. 1982, Levy and Northcote 1982, Healey 1991). The brackish water areas in estuaries moderate the physiological stress that occurs during parr-smolt transitions. Although fry and fingerlings can enter the Delta as early as January and as late as June, their length of residency within the Delta is unknown but probably lessens as the season progresses into the late spring months (DFG 1998).

In preparation for their entry into a saline environment, juvenile salmon undergo physiological transformations known as smoltification that adapt them for their transition to salt water. These transformations include different swimming behavior and proficiency, lower swimming stamina, and increased buoyancy that also make the fish more likely to be passively transported by currents (Saunders 1965, Folmar and Dickhoff 1980, Smith 1982). In general, smoltification is timed to be completed as fish are near the fresh water to salt water transition. Too long a migration delay after the process begins is believed to cause the fish to miss the "biological window" of optimal physiological condition for the transition (Walters et al. 1978). The optimal thermal range for chinook during smoltification and seaward migration is 50° F to 55° F (Rich 1997).

Chinook salmon spend between one and four years in the ocean before returning to their natal streams to spawn (Myers et al. 1998). Fisher (1994) reported that 87% of returning spring-run adults are three-years-old based on observations of adult chinook trapped and examined at Red Bluff Diversion Dam between 1985 and 1991.

Central Valley Spring-run Chinook Designated Critical Habitat

On February16, 2000, NMFS designated critical habitat for the Central Valley spring-run chinook salmon evolutionarily significant unit (ESU; 63 FR 11482). Critical habitat consists of the water, substrate, and adjacent riparian zone of accessible estuarine and riverine reaches. Accessible reaches are those within the historical range of the Central Valley spring-run chinook ESU that can still be occupied by any life stage of chinook salmon. Inaccessible reaches are those above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years) and specific dams within the historical range of each ESU. Adjacent riparian zones are defined as the area adjacent to a stream that provides the following functions: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter.

Critical habitat for Central Valley spring-run chinook is designated to include all river reaches accessible to chinook salmon in the Sacramento River and its tributaries in California. Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded are areas above specific dams or above longstanding naturally impassable barriers.

Central Valley Steelhead - Threatened

<u>Status and trends</u>.
Effective May 18, 1999, NMFS listed Central Valley steelhead as threatened under the Endangered Species Act (63 FR 13347). Central Valley steelhead once ranged throughout most of the tributaries and headwaters of the Sacramento and San Joaquin basins prior to dam construction, water development, and watershed perturbations of the 19th and 20th centuries (McEwan and Jackson 1996). Historical documentation exists that show steelhead were once widespread throughout the San Joaquin River system (CALFED 1999). In the early 1960s, the California Fish and Wildlife Plan estimated a total run size of about 40,000 adults for the entire Central Valley including San Francisco Bay. The annual run size for this ESU in 1991-92 was probably less than 10,000 fish based on dam counts, hatchery returns and past spawning surveys (McEwan and Jackson 1996).

Estimates of steelhead historical habitat can be based on estimates of salmon historical habitat. The extent of habitat loss for steelhead is probably greater than losses for salmon, because steelhead go higher into the drainages than do chinook salmon (Yoshiyama et al. 1996). Clark (1929) estimated that originally there were 6,000 miles of salmon habitat in the Central Valley system and that 80% of this habitat had been lost by 1928. Yoshiyama et al. (1996) calculated that roughly 2,000 miles of salmon habitat was actually available before dam construction and mining, and concluded that 82% of what was present is not accessible today. Clark (1929) did not give details about his calculation. Whether Clark's or Yoshiyama's calculation is used, only remnants of the former steelhead range remain accessible today in the Central Valley.

As with Central Valley spring-run chinook, impassable dams block access to most of the historical headwater spawning and rearing habitat of Central Valley steelhead. In addition, much of the remaining, accessible spawning and rearing habitat is severely degraded by elevated water temperatures, agricultural and municipal water diversions, unscreened and poorly screen water intakes, restricted and regulated streamflows, levee and bank stabilization, and poor quality and quantity of riparian and SRA cover.

At present, wild steelhead stocks appear to be mostly confined to upper Sacramento River tributaries such as Antelope, Deer, and Mill creeks and the Yuba River (McEwan and Jackson 1996). Naturally spawning populations are also known to occur in Butte Creek, and the upper Sacramento, Feather, American, Mokelumne, and Stanislaus rivers (CALFED 1999). However, the presence of naturally spawning populations appears to correlate well with the presence of fisheries monitoring programs, and recent implementation of new monitoring efforts has found steelhead in streams previously thought not to contain a population, such as Auburn Ravine, Dry Creek, and the Stanislaus River. It is possible that other naturally spawning populations exist in Central Valley streams, but are undetected due to lack of monitoring or research programs (IEP Steelhead Project Work Team 1999).

Life history and habitat requirements.

All Central Valley steelhead are currently considered winter-run steelhead (McEwan and Jackson 1996), although there are indications that summer steelhead were present in the Sacramento River system prior to the commencement of large-scale dam construction in the 1940's (IEP Steelhead Project Work Team 1999). Adult steelhead migrate upstream in the Sacramento River mainstem from July through March, with peaks in September and February (Bailey 1954, Hallock et al. 1961). The timing of upstream migration is generally correlated with higher flow events, such as freshets or sand bar breaches, and associated lower water temperatures. The preferred temperatures for upstream migration are between 46° F and 52° F (Reiser and Bjornn 1979, Bovee 1978, Bell 1986). Unusual stream temperatures during upstream migration periods can alter or delay migration timing, accelerate or retard mutations, and increase fish susceptibility to diseases. The minimum water depth necessary for successful upstream passage is 18 cm (Thompson 1972). Velocities of 3-4 meters per second approach the upper swimming ability of steelhead and may retard upstream migration (Reiser and Bjornn 1979).

Spawning may begin as early as late December and can extend into April with peaks from January through March (Hallock et al. 1961). Unlike chinook salmon, not all steelhead die after spawning. Some may return to the ocean and repeat the spawning cycle for two or three years; however, the percentage of repeat spawners is generally low (Busby et al. 1996). Steelhead spawn in cool, clear streams featuring suitable gravel size, depth, and current velocity. Intermittent streams may be used for spawning (Barnhart 1986, Everest 1973). Gravels of 1.3 cm to 11.7 cm in diameter (Reiser and Bjornn 1979) and flows of approximately 40-90 cm/second (Smith 1973) are generally preferred by steelhead. Reiser and Bjornn (1979) reported that steelhead prefer a water depth of 24 cm or more for spawning. The survival of embryos is reduced when fines of less than 6.4 mm comprise 20 - 25% of the substrate. Studies have shown a survival of embryos improves when intragravel velocities exceed 20 cm/hour (Phillips and Campbell 1961, Coble 1961). The preferred temperatures for spawning are between 39° F and 52° F (McEwan and Jackson 1996).

Length of time required for eggs to develop and hatch is dependant on water temperature and is quite variable; hatching varies from about 19 days at an average temperature of 60° F to about 80 days at an average of 42° F. The optimum temperature range for steelhead egg incubation is 46° F to 52° F (Reiser and Bjornn 1979, Bovee 1978, Bell 1986, Leidy and Li 1987). Egg mortality may begin at temperatures above 56° F (McEwan and Jackson 1996).

After hatching, pre-emergent fry remain in the gravel living on yolk-sac reserves for another four to six weeks, but factors such as redd depth, gravel size, siltation, and temperature can speed or retard this time (Shapovalov and Taft 1954). Upon emergence, steelhead fry typically inhabit shallow water along perennial stream banks. Older fry establish territories which they defend. Streamside vegetation is essential for foraging, cover, and general habitat diversity. Steelhead juveniles are usually associated with the bottom of the stream. In winter, they become inactive and hide in available cover, including gravel or woody debris.

The majority of steelhead in their first year of life occupy riffles, although some larger fish inhabit pools or deeper runs. Juvenile steelhead feed on a wide variety of aquatic and terrestrial insects, and emerging fry are sometimes preyed upon by older juveniles. Water temperatures influence the growth rate, population density, swimming ability, ability to capture and metabolize food, and ability to withstand disease of these rearing juveniles. Rearing steelhead juveniles prefer water temperatures of 45° F to 60° F (Reiser and Bjornn 1979, Bovee 1978, Bell 1986). Temperatures above 60° F have been determined to induce varying degrees of chronic stress and associated physiological responses in juvenile steelhead (Leidy and Li 1987).

After spending one to three years in freshwater, juvenile steelhead migrate downstream to the ocean. Most Central Valley steelhead migrate to the ocean after spending two years in freshwater (Hallock et al. 1961, Hallock 1989). Barnhart (1986) reported that steelhead smolts in California range in size from 14 to 21 cm (fork length). In preparation for their entry into a saline environment, juvenile steelhead undergo physiological transformations known as smoltification that adapt them for their transition to salt water. These transformations include different swimming behavior and proficiency, lower swimming stamina, and increased buoyancy that also make the fish more likely to be passively transported by currents (Saunders 1965, Folmar and Dickhoff 1980, Smith 1982). In general, smoltification is timed to be completed as fish are near the fresh water to salt water transition. Too long a migration delay after the process begins is believed to cause the fish to miss the "biological window" of optimal physiological condition for the transition (Walters et al. 1978). The optimal thermal range during smoltification and seaward migration for steelhead is 44° F to 52° F (Leidy and Li 1987, Rich 1997) and temperatures above 55.4° F have been observed to inhibit formation and decrease activity of gill (Na and K) ATPase activity in steelhead, with concomitant reductions in migratory behavior and seawater survival (Zaugg and Wagner 1973, Adams et. al 1975). Hallock et al. (1961) found that juvenile steelhead in the Sacramento Basin migrated downstream during most months of the year, but the peak period of emigration occurred in the spring, with a much smaller peak in the fall.

Steelhead spend between one and four years in the ocean (usually one to two years in the Central Valley) before returning to their natal streams to spawn (Barnhart 1986, Busby et al. 1996).

Central Valley Steelhead Designated Critical Habitat

On February16, 2000, NMFS designated critical habitat for the Central Valley steelhead evolutionarily significant unit (ESU) (63 FR 11482). Critical habitat consists of the water, substrate, and adjacent riparian zone of accessible estuarine and riverine reaches. Accessible reaches are those within the historical range of the Central Valley steelhead ESU that can still be occupied by any life stage of steelhead. Inaccessible reaches are those above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years) and specific dams within the historical range of each ESU. Adjacent riparian zones are defined as the area adjacent to a stream that provides the following functions: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter. Critical habitat for Central Valley steelhead is designated to include all river reaches accessible to listed steelhead in the Sacramento and San Joaquin Rivers and their tributaries in California. Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded are areas of the San Joaquin River upstream of the Merced River confluence and areas above specific dams or above longstanding naturally impassable barriers.

ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat, and ecosystem within the action area (USFWS and NMFS 1998). The action area includes Stony Creek and its riparian corridor from East Park Reservoir downstream to the confluence with the Sacramento River.

The main focus of this analysis centers on the area that is accessible to anadromous species and is designated as critical habitat for Central Valley spring-run and steelhead, the lower 24.6 miles of Stony Creek between Black Butte Dam and the confluence with the Sacramento River.

The Stony Creek Watershed is characterized by cool, wet winters with high flows, and hot dry summers with low summer and fall flows, with an average precipitation of 15 inches in the lower watershed. Within the upper watershed, variable winter rains and snow (annual precipitation of 32 inches) provide inflow into the reservoirs for storage which affect water releases to lower Stony Creek. Since 1921, estimated unimpaired flows have been virtually zero from June through October in most years. The highest peak flow at the Black Butte Lake site was 60,000 cubic feet per second (cfs) on December 11, 1937, with a 3-day volume of 102,000 acre-feet. In February of 1986, the 3-day volume was 173,000 acre-feet, but the peak inflow did not surpass 60,000 cfs.

Status of the Listed Species within the Action Area

Although chinook salmon and steelhead are known to occur in lower Stony Creek, information on recent spawning is greatly limited. The installation of the Glenn Colusa Irrigation District (GCID) siphon under Stony Creek in 1999 has opened up much of the lower creek to anadromous salmonid use over a much greater portion of the year. Prior to installation of the siphon, a gravel berm existed at the GCID canal crossing of Stony Creek at CM 3.3 which created an intermittent barrier to both upstream and downstream salmonid migration. In many years this berm was able to withstand winter flows and therefore blocked passage throughout the year. In those years that the berm was washed out by high winter flows, it was generally rebuilt early in the spring (March or April) to allow irrigation water delivery. Even with the removal of this intermittent barrier, the potential for recovery of salmonid populations within lower Stony Creek is currently limited by passage barriers and diversions such as NDD and the CHO as well as frequent fluctuations in stream flows with extended periods of extremely low base flows, elevated water temperatures and limited spawning and rearing habitat.

Central Valley Spring-run and Sacramento Winter-run Chinook Salmon

Spring-run chinook salmon are known to have historically occurred in the Stony Creek watershed (Yoshiyama et al. 1995). There is documentation of salmon spawning at the confluence of Stony Creek and Little Stony Creek, although habitat conditions in this reach would indicate that these were likely fall run chinook salmon. The spring run are likely to have spawned further up in the watershed above 2,000 feet of elevation. Prior to the placement of irrigation dams, Stony Creek was considered "a very good salmon stream" (Clark 1929). By 1928 spring-run chinook salmon were nonexistent on Stony Creek due to irrigation diversions that blocked migration to the upper watershed and kept the lower stream dry except during the rainy season (Clark 1929). There is no evidence or documentation of winter-run chinook salmon spawning in Stony Creek.

The life history and spawning strategies of spring run chinook salmon require them to reach cold water habitats during the summer and fall seasons. The construction of Stony Gorge and

Black Butte Dams blocked the spring-run from accessing the cold water habitats of upper Stony Creek in order to complete their life cycle. This loss of access to cold water habitats has caused the complete extirpation of spawning populations of spring-run chinook salmon from the Stony Creek watershed. It is unlikely that any action short of the complete removal of the dams could facilitate the return of a spawning population of spring-run chinook salmon to the system.

Several sampling efforts conducted over the past 20 years have captured juvenile spring-, and winter-run chinook salmon and steelhead in Stony Creek, mostly near the confluence with the Sacramento River (Maslin and McKinney 1994, Brown 1995, Reavis 1983). In addition, juvenile chinook salmon have been collected as far upstream as CM 20.9 (DFG 1983). It is suspected that the majority of juveniles found within Stony Creek in recent years represent non-natal rearing populations. However, fall-run chinook salmon spawning has been documented during this period and there is insufficient data to determine the origin of the captured juveniles. Comprehensive sampling efforts to ascertain spawning usage and juvenile production within Stony Creek are under way to clarify these uncertainties.

Central Valley Steelhead

There have been no previous studies specifically designed to determine the presence or extent of steelhead spawning on Stony Creek and there is therefore, no documentation of any such spawning. Murphy (1946) conducted a survey of the upper reaches of Stony Creek and Grindstone Creek (a tributary to Stony Creek) in August of 1946, prior to the existence of Black Butte Dam, during which he documented abundant rainbow trout. The existence of rainbow trout (and possibly juvenile steelhead) in these areas during the late summer of a drought year indicates that the habitat was suitable to support steelhead on a year round basis. The suitability of the habitat coupled with the documentation of anadromous chinook salmon accessing these areas (Yoshiyama 1995) is a strong indication that steelhead would have spawned in Stony Creek as well (McEwan 2001).

Evidence supporting the assumption that steelhead distribution can be inferred from chinook salmon distribution is provided in a comparison of the distributions of the two species in recent fish sampling in the lower Klamath River tributaries which demonstrates that steelhead were present in all tributaries that contain chinook salmon, and, in nearly all cases, steelhead were found in areas further upstream than salmon (Voight and Gale 1998). Additionally, an extensive review done by CH2M Hill (1995) of salmonid distribution in the anadromous portions of the entire Klamath-Trinity River system found only one tributary containing chinook salmon but lacking steelhead. All other tributaries that supported chinook salmon also supported steelhead and, in nearly all cases, steelhead were distributed at higher elevations in the stream than were chinook salmon.

Current habitat conditions in lower Stony Creek are at best marginal, but may provide the necessary elements to allow successful steelhead reproduction in most years. These conditions have been documented to support successful chinook salmon spawning (Reavis 1983). Water temperatures are optimal (<56° F) throughout the primary steelhead spawning period (December through March) although temperatures can rise quickly in the spring, leaving the potential for late spawned redds to be lost to lethal temperature conditions. Summertime water temperatures are also well above the lethal level for steelhead, precluding the possibility for steelhead to rear in Stony Creek over the summer. Instead, they would be forced to migrate downstream to the mouth of the creek and into the Sacramento River, where temperatures generally remain suitable for juvenile rearing throughout the year. The quality of available spawning gravels is also questionable. Studies have shown a relatively high level of sand content in the substrate (Puckett 1969; Vogel 1998) although a comprehensive examination of the entire creek has not been conducted in over 30 years. Again recent evidence of successful spawning and emergence of chinook salmon indicates that there are areas of suitable spawning substrate within lower Stony Creek. Flows are generally sufficient (≥50 cfs) to maintain some spawning habitat throughout the winter. Most of the obstacles to successful reproduction and survival faced by steelhead in lower Stony Creek (low flows, limited access, severe fluctuations) are operational in nature and could potentially be remedied by changes in operational procedures.

Factors Affecting Species Environment within the Action Area

The essential features of freshwater salmonid habitat include adequate (1) substrate; (2) flow (water quantity, water velocity); (3) water temperature; (4) riparian habitat and instream structural diversity (cover or shelter, food, riparian shading); (5) safe passage conditions and; (6) habitat quality (water quality, effect of land-use activities). These features have been affected by human activities such as water impoundments, flood control, water diversions, mining, and agriculture throughout lower Stony Creek. Impacts to essential habitat features have led to a reduction in salmonid populations within Stony Creek.

Substrate/Spawning Habitat

Black Butte Dam has altered the flow regime of lower Stony Creek and blocked the transport of sediment from the upper basin. Prior to construction of the dam, the channel was a high gradient, bedload dominated system with sharp fluctuations in discharge, where the channel carrying the main flow shifted periodically. Post-dam, the flood peaks have been attenuated, and storm run-off is stored for planned releases. Channel width and sediment transport have been reduced in the upper reaches and significant channel realignment has occurred. The sources of most bedload and suspended sediment have been eliminated by the dam. High volume flood control releases can produce accelerated bank erosion below the dam, which is the only source of coarse bedload within this lower reach.

A spawning habitat survey on lower Stony Creek was conducted by DFG in the mid-1960's (Puckett 1969). In this investigation, three potential salmonid spawning areas were evaluated for their suitability to provide adequate spawning conditions. The three 0.5-mile reaches investigated within lower Stony Creek were at the U.S. Geological Survey (USGS) gage near Hamilton City, 0.5 mile downstream of Road P crossing near Orland, and two miles below Black Butte Dam (Puckett 1969). In this study, three criteria were used to define the amount of usable spawning area available at various flows: gravel size, depth, and velocity. After conducting gravel size analyses during the first year of this investigation, the two lower study locations were not evaluated further because of their unsuitability for chinook salmon spawning. The remaining study reach, two miles below Black Butte Dam, was monitored for an additional year to evaluate spawning suitability at varying flow conditions.

The results of this 1960's investigation determined that the substrate particle size was too small in the two lower study areas, but was adequate for chinook spawning in the upper most location. It should be noted that this study was conducted shortly after the completion of Black Butte Dam, before the impacts of the dam on substrate composition and distribution would have been apparent. It is likely that the substrate characteristics throughout lower Stony Creek have changed significantly in the ensuing 35 years of dam operations.

A substrate study conducted by David Vogel (1998) in the upper reaches of lower Stony Creek concluded that "nearly all samples possessed a level of fine particles (mostly sand) within the level of concern for salmonid reproduction". Vogel reported that the level of sand sized particles was within the level of concern that would probably adversely impact salmon fry emergence success. However, the average level of fines detected in Vogel's sampling was only slightly above (<8%) the level which has been found to affect egg and alevin survival (Bjorn 1969; Rantz 1964) and no adjustment was made for the ability of spawning salmonids to clean away much of these fine sediments in the process of creating their redds. Vogel has also observed that the "overall physical habitat conditions, e.g., rearing habitats necessary for salmon production were poor compared to numerous salmon-producing rivers and streams...on the west coast." Changes in flood flow releases, loss of upstream gravel recruitment, and continuing aggregate mining have most likely degraded the habitat suitability for salmonid spawning in lower Stony Creek.

It should be noted that Vogel concentrated a large majority of his sampling effort (15 of 18 samples) within the upper two miles of the creek, directly below Black Butte Dam. The decision to concentrate on this area was apparently based on Puckett's finding that this area had contained the highest quality spawning substrate some 30 years prior. However, as stated above, it is likely that 30 years of gravel starvation and torrential flood releases from the dam have had adverse impacts on the quality of substrate in this area and that it is no longer the best suited for salmonid spawning. The remaining three samples taken by Vogel were collected far downstream, below the Glenn Colusa Canal crossing, leaving nearly 20 miles of Stony Creek substrate unsampled and unknown. The fisheries monitoring plan proposed by Reclamation is expected to provide a more comprehensive and up-to-date analysis of substrate conditions throughout lower Stony Creek.

Hydrologic Conditions.

Natural flow patterns within Stony Creek have been disturbed since 1910 with the construction of East Park Dam. Changes in the natural flow regime have altered the natural cycles by which juvenile and adult salmonids base their migrations. Construction of the dams and the subsequent storage and diversion of natural flows have depleted streamflows and contributed to higher temperatures, lower dissolved oxygen levels, and decreased gravel and large woody debris recruitment. The existing streamflow conditions below Black Butte are variable and highly dependant on flood control operations, diversions, seepage, and evaporation. Historic records indicate that before the construction of Black Butte Dam (1963), flows in the lower valley reach of Stony Creek diminished to zero or nearly zero in the late summer months of most years. This situation continues to occur today as minimal releases (30 cfs or less) can be diminished through evaporation, direct pumping or absorption into the fluvial substrate of the valley floor before reaching the Sacramento River.

Flood Control.
A representative sample of daily data for Black Butte outflow obtained from the COE for water years 1996 to 1998 shows that day to day flow fluctuations due to flood control operations can be large, on the order of 100-1300 percent of the prior day's flow, and range in magnitude from several hundred to approximately 6,000 cfs in a single day. These flow fluctuations have the potential to cause stranding of fish, scouring of spawning areas and severe bank erosion.

Stony Creek records show that flows in the range of 1,000 to 5,000 cfs during the winter months are common. According to Vogel, (TCCA White Paper, March 25, 1996), "flows of this magnitude occurred for several weeks or more in approximately two-thirds to four-fifths of the 24 years of record. Even extreme flow events of greater than 10,000 cfs and 15,000 cfs occurred 38 and 17 percent of the years, respectively." Although this magnitude of flows have historically, and do commonly occur in natural environments, there is the potential for such high flows coupled with the extreme levels of fluctuation seen on Stony Creek, to cause sufficient bedload movement to scour or suffocate redds.

Temperature
Six continuous surface temperature monitoring gages are located on lower Stony Creek: below Black Butte Dam (CM 24), below NDD (CM 19.7), at old Highway 99 bridge near I-5 (CM 15.5), below TCC (CM 13), at St. John's Gage (CM 7), and below GCID Main Canal (CM 1.5) near the Nature Conservancy (creek mile locations are approximate). The TCC and GCID gages were not used for analysis due to unexplained inconsistencies in temperature recordings. It is believed these gages have been buried with sediment and are recording groundwater temperatures.

Lower Stony Creek stream temperatures are directly influenced by ambient air temperature, solar radiation, shading, channel geometry, the water temperatures of Black Butte releases, and, to a lesser degree, the other upstream reservoirs. Releases made from Black Butte are made from the outlet located at the bottom of the reservoir, ensuring the coldest temperatures possible. Thermal monitoring within Black Butte has indicated that, while there is a slight to moderate thermal stratification during the late spring and summer months (April-September), by the early fall at lowest pool elevations, temperatures within the reservoir can be relatively uniform, generally in the mid 60's°F (COE 1987, DWR 1988). Based on analysis of daily mean temperatures from the four monitoring locations used on lower Stony Creek from July 1995 to December 1997, temperatures have remained fairly consistent from year to year during the winter months. Also, stream temperatures were not significantly different with regard to location during the winter months but increased as much as 18°F between CM 24 and CM 7 in the downstream direction from May to August.

Dates for which mean historic daily water temperatures exceeded 65°F in the spring were obtained from Stony Creek water temperature records measured at the Black Butte gage (CM 24) between 1979 to 1994. These dates are shown in Table 1. Dates in which temperature conditions in Stony Creek became suboptimal for rearing fry/juvenile chinook salmon and steelhead (>65°F) ranged from as early as April 21 (1981) to as late as June 13 (1983). In addition, Table 1 shows that temperatures in lower Stony Creek provide optimal conditions for juvenile chinook for approximately 84 days, on average, following fry emergence.

Mean daily water temperatures in October (65.8°F) exceeded the maximum threshold of temperature tolerances for prespawning chinook salmon during 1979-1994. During 1979-1994, water temperatures from November (54.4°F) through March in the study area remained below the threshold of prespawning/spawning (60°F) and egg incubation temperatures (56°F) for chinook. Stream temperatures then remained within the optimal range (<65°F) for fry/juvenile chinook and steelhead rearing through at least April and sometimes to mid-June. The number of days in which rearing temperatures were suitable for fry/juvenile chinook salmon ranged from as few as 42 to 55 (1988) to as many as 105 to 121 (1983) with an average of 84 days.

With regards to late fall run chinook salmon and steelhead trout, these data indicate that in most years, spawning could continue only into mid February while still leaving enough time for fry emergence prior to suboptimal temperature conditions in the spring.

Table 1
Estimated Dates of Spawning and Emergence of Chinook Salmon Fry
Based on Daily Mean Stony Creek Water Temperature
(Measured at Black Butte USGS Gage)

Year [a]	Initial Spawning Date Based on Reaching Optimal Egg Incubation Temperature	Estimated Dates of Fry Emergence[bc]	Date When Water Temperature Exceeds 65°F	Number of Predicted Suitable Temperature Days
1979	10 Nov	24 Feb to 8 Mar	21 May	75 to 86
1980	13 Nov	10 Feb to 25 Feb	18 May	83 to 97
1981	15 Nov	9 Feb to 22 Feb	21 Apr	58 to 71
1983	7 Nov	12 Feb to 28 Feb	13 Jun	105 to 121
1986	12 Nov	12 Feb to 25 Feb	9 May	73 to 85
1988	25 Nov	2 Mar to 15 Mar	26 Apr	42 to 55
1989	15 Nov	25 Feb to 11 Mar	24 May	74 to 88
1991	15 Nov	16 Feb to 2 Mar	2 Jun	92 to 106

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Year[a]	Initial Spawning Date Based on Reaching Optimal Egg Incubation Temperature	Estimated Dates of Fry Emergence[bc]	Date When Water Temperature Exceeds 65°F	Number of Predicted Suitable Temperature Days
1993	10 Nov	23 Feb to 12 Mar	23 May	72 to 89
1994	6 Nov	16 Feb to 2 Mar	26 Apr	55 to 69

[a]Using temperature data for only those years where accurate information allowed estimates to temperature thresholds being reached (data available for water years 1979 to 1994).
[b]Assuming spawning would be accomplished within 14 days following temperatures falling below 58°F.
[c]Assuming the accumulation of 1600 temperature units.

<u>Riparian Habitat/Instream Structural Diversity.</u>
The overall habitat quality of the riparian plant communities observed for lower Stony Creek is low with respect to species composition, extent and level of reestablishment, and stand maintenance. There are some pockets of moderate to high-quality riparian habitat mostly above CM 15, above the TCC, and in the lowermost 2 miles. Interpretation of 1992 aerial photographs shows scattered patches of shrubs, typically well removed from the active channel. Much of the riparian habitat is severely infested with invasive species such as giant reed and tamarix. Weed invasion is more prevalent downstream of the I-5 bridge.

Riparian vegetation along Stony Creek below Black Butte Dam extends intermittently along the creek from just below the south side outlet to the Sacramento River. Preliminary information based on documents and field observations determined that four riparian plant community series occur within the creek active zone and bank. In addition, two community series occur in the outer floodplain. The giant reed series and California annual grassland series were the only series that include a major non-native plant species component. In Table 2, the vegetation series are divided into zones based on their occurrence within Stony Creek, such as the active zone that is within the active channel of the creek, the border zone which includes the banks of the channel, and the outer zone which is the upper terraces of the floodplain. Acreages of riparian habitats on lower Stony Creek as mapped from 1992 aerial photographs are provided in Table 2. Reaches are described as Reach 1 (CM 24.6 to 15.9), Reach 2 (CM 15.9 to 12.3), Reach 3 (CM 12.3 to 7) and Reach 4 (CM 7 to 0, or the Sacramento River).

The extent of any one series is not completely known because of limited access along Stony Creek during the reconnaissance survey. Aerial photograph interpretation with on-ground investigation will improve the understanding of the extent and types of series currently present. The observations that have been made indicate that the majority of extensive, higher quality riparian series occur above gravel mining and canal diversion areas. Field observations and cursory aerial photograph analysis determined that some relatively recent gravel bars had formed, such as one just above the Northside Canal, where riparian plants appearing to be mule fat and sandbar willow had become densely established on a gravel bar within the last few years. Also, just below Black Butte Dam a shoreline gravel bar supported a dense growth of 5- to 15-year old riparian vegetation including arroyo and sandbar willow, and mule fat.

Riparian areas that were observed in the field that contained more mature vegetation and greater diversity of species, including white alder and Fremont cottonwood, appeared to be uncommon. Those specific areas observed were not extensive, and the taller, mature trees were restricted to narrow creek banks that were in a state of erosion. Further site-specific field observations of the larger denser riparian areas would be required to determine if white alder and Fremont cottonwood existed in the high-quality sites and if they are becoming established in those sites.

Giant reed has become well established along most of lower Stony Creek from CM 0 to approximately CM 17. It has become established as dense thickets in the areas where gravel mining activities create a disturbance threshold that exceeds the maintenance and regeneration capabilities of the native riparian vegetation. Displacement of vegetated bars by unstable channel reaches favors giant reed over native shrubs because it spreads easily from stem and root fragments or entire plants transport downstream. Giant reed has entered the mature riparian vegetation such as Fremont cottonwood, arroyo willow, and white alder stands that persist along the eroding banks. It has been found that giant reed can disturb the normal regeneration cycles of native riparian species and will ultimately form a monoculture (Rieger and Kreager 1988).

Table 2
Stony Creek Vegetation by Reach, 1992

Reach	Zone	Unit	Acreage
1	Active	Open Water	99
1	Active	Gravel Bar	189
1	Border	Willow Riparian Scrub	21
1	Border	Herbaceous Riparian	179
1	Border	Valley Oak/Cottonwood Riparian Woodland	196
1	Outer	Valley Oak Woodland	188
1	Outer	California Annual Grassland	1,438

Table 2 Stony Creek Vegetation by Reach, 1992			
Reach	**Zone**	**Unit**	**Acreage**
Total			**2,309**
2	Outer	California Annual Grassland	1,336
2	Active	Gravel Bar	506
2	Active/Border	Giant Reed	84
2	Border	Willow Riparian Scrub	13
2	Border	Herbaceous Riparian Scrub	332
2	Border	Valley Oak/Cottonwood Riparian Woodland	189
2	Outer	Valley Oak Woodland	29
2	Active	Open Water	206
Total			**2,696**
3	Active	Open Water	225
3	Active	Gravel Bar	568
3	Active/Border	Giant Reed	79
3	Border	Willow Riparian Scrub	225
3	Border	Herbaceous Riparian	398
3	Border	Valley Oak/Cottonwood Riparian Woodland	42
Total			**1,536**
4	Active	Open Water	110
4	Active	Gravel Bar	56
4	Active/Border	Giant Reed	10
4	Border	Herbaceous Riparian	44
4	Border	Valley Oak/Cottonwood Riparian Woodland	33
Total			**253**

Passage Barriers and Entrainment

Salmonid passage was originally blocked by East Park Dam and the associated Rainbow Diversion Dam in 1910 and 1914 respectively. Eighteen years later Stony Gorge Dam further prevented salmonid passage into the upper watershed. Since 1963, salmonids have been restricted to the lower 24.6 miles of Stony Creek by Black Butte Dam.

The NDD located at CM 19.7 is a weir structure spanning the entire creek. The concrete spillway creates a nearly vertical drop of approximately 4 feet to the downstream water surface which may pose a problem for upstream adult passage under low flow conditions, and makes it impossible for juveniles to move upstream of the dam at any time. On top of this spillway, flashboards are typically put in place from March through October. However, these flashboards have, at times, been in place during all months of the year dependant on water demands and weather patterns. When flashboards are in place they create a total barrier to upstream passage so that adult and juvenile salmonids are unable to access the area above the NDD. In addition, any juveniles migrating downstream from above the diversion dam would have a strong likelihood of entrainment into the North Canal as the majority of the water flowing downstream is diverted into the canal. NDD flashboards are typically in place during much of the fall-run chinook adult migration period and during the fall-, late fall-run chinook, and steelhead juvenile emigration periods.

Since 1993, a seasonal passage impediment has existed at the CHO (CM 13) during rediversion operations which may occur from April 1 through May 15 and September 15 through October 29. During CHO operations, a gravel barrier is placed across Stony Creek to facilitate the diversion of water into the TCC via the CHO. Although a minimum bypass flow of 40 cfs is maintained downstream of this seasonal berm during the operation of the CHO, this temporary barrier may prevent both upstream and downstream passage of salmonids. As with the NDD, any juveniles migrating downstream from above the diversion structure would have a strong likelihood of entrainment into the TCC as the majority of the water flowing downstream is diverted into the canal during much of the diversion period. Upstream passage may be prevented or delayed during the fall-run chinook adult immigration period and during the fall-, late fall-, spring-run chinook, and steelhead juvenile emigration periods.

Prior to 1999, a gravel berm was constructed on the creek each spring at the GCID main canal (approximately 3 miles upstream of the confluence of Stony Creek and the Sacramento River) and left in place through the irrigation season (generally March through November). The berm created a barrier which prevented fish passage into and out of the creek during the irrigation season. In 1999, a siphon was placed under Stony Creek at this site, and there is no longer any structural barrier there.

In addition to instream structural impediments and/or barriers, instream flows may pose a potential passage barrier or impediment to migratory salmonids. Estimates of flow levels necessary to attract and allow upstream migration of adult salmon in lower Stony Creek vary, ranging from 50 to 200 CFS at the mouth. Flow requirements necessary to optimize chinook salmon habitat for all life stages will be studied in the proposed Fisheries Management Study.

Mining.
Since 1977, DFG has allowed no instream pit mining in Stony Creek and has encouraged off-stream mining that is isolated from flowing water, maintains stream bank protection

conditions, and limits elevations of gravel removal to maintain appropriate slopes. Gravel bar skimming is the typical gravel technique used in lower Stony Creek, however, excavation below the level of seasonally replenished aggregate has occurred in the area east and west of the Highway 32 bridge (Glenn County 1997).

In areas where gravel mining activities create a disturbance threshold that exceeds the maintenance and regeneration capabilities of the native riparian vegetation, invasive weeds such as the Giant reed have become established.

Agriculture/Bank Stabilization.
Land use activities associated with agriculture have altered fish habitat quantity and quality through alteration of streambank and channel morphology; elimination of downstream recruitment of gravel and large woody debris; elimination of spawning and rearing habitat; and ground-water pumping which lowers the water table and causes Stony Creek water to absorb into the surrounding alluvium. In addition, unscreened water diversions for agriculture and municipal use may result in direct entrainment of emigrating salmonid juveniles.

Species Interactions.
In addition to salmonids, lower Stony Creek supports a wide variety of native non-salmonid migratory and resident species, and numerous introduced non-salmonid species. These species may compete with chinook salmon and steelhead for food and/or suitable habitat, and several may prey upon salmonid fry and juveniles. The abundance of these species and potential for adverse impacts to salmonids is unknown at this time. Table 3 shows all fish species reported from various past studies of Stony Creek. The table gives the species names, status as to being exotic or native to the creek, and the area in which they were found.

Table 3
Fish Species Reported In The Stony Creek Watershed

Common Name	**Scientific Name**	**Native / Exotic (N/E)**	**Above Black Butte Dam**	**Below Black Butte Dam**	**Source**
Chinook Salmon	*Oncorhynchus tshawytscha*	N		X	a,c,d
Steelhead Trout	*Oncorhynchus mykiss mykiss*	N		X	d
Rainbow Trout	*Oncorhynchus mykiss*	N	X		a,b,c
Sacramento Sucker	*Catostomus occidentalis*	N		X	a,b
Common Carp	*Cyprinus carpio*	E	X	X	a,b,c
Sacramento Squawfish	*Ptychocheilus grandis*	N		X	a,b
California Roach	*Hesperoleucus symmetricus*	N		X	a.b

Speckled Dace	*Rhinichthys osculus*	N		X	a,b
Brown Bullhead	*Ictalurus nebulosus*	E		X	a
Mosquitofish	*Gambusia affinis*	E		X	a,b
Largemouth Bass	*Micropterus salmoides*	E	X	X	a,b,c
Green Sunfish	*Lepomis cyanellus*	E	X	X	a,b,c
Bluegill Sunfish	*Lepomis marcochirus*	E	X	X	a,b,c
Threespine Stickleback	*Gasterosteus aculeatus*	N		X	a,b
Bigscale Logperch	*Percina macrolepida*	E		X	b
Riffle Sculpin	*Cottus gulosus*	N		X	b
Prickley Sculpin	*Cottus asper*	N		X	b
Hitch	*Lavinia exilicauda*	N		X	b
Golden Shiner	*Notemigonus crysoleucas*	E		X	b
Hardhead	*Mylopharodon conocephalus*	N	X	X	b,c
White Crappie	*Pomoxis annularis*	E	X	X	b,c
Black Crappie	*Pomoxis nigromaculatus*	E	X		c
Striped Bass	*Morone saxatalis*	E	X		c
Smallmouth Bass	*Micropterus dolomieu*	E	X	X	b,c
Channel Catfish	*Ictalurus punctatus*	E	X	X	b,c
White Catfish	*Ameiurus catus*	E	X	X	b,c
Black Bullhead	*Ameiurus melas*	E		X	b
Tule Perch	*Hysterocarpus traski*	N		X	b
Warmouth	*Lepomis gulosus*	E		X	b
Threadfin Shad	*Dorosoma petenese*	E	X	X	b,c
Redear Sunfish	*Lepomis microlophus*	E	X		c
Lampery	*Lampetra spp.*	N		X	b

Sources:
a. Puckett, 1969.
b. M. Brown, 1995.
c. DFG (unpublished files Region II).
d. Maslin and McKinney, 1994.

EFFECTS OF THE ACTION

For purposes of this opinion, temperature and flow evaluations below Black Butte Dam are based on historical records for the period 1979-1994 (fry emergence temperatures; Reclamation 1998), water years 1996 to 1998 (flows; Reclamation 1998), and September 1995 through December 1997 (temperatures, storage, and flows; Reclamation and Corps 2001).

Facilities Above Black Butte Dam

East Park Dam and Reservoir.
The construction of East Park Dam in 1910 and the associated Rainbow Diversion Dam in 1914 created permanent barriers to salmonid migration eliminating all access to the spawning and rearing habitat in Little Stony Creek above East Park Dam and in Stony Creek above Rainbow Diversion Dam. Operation of East Park Reservoir, including the storage and subsequent release of water, altered the natural flow regime by which juvenile and adult salmonids based their migrations. This altered flow regime also upset the natural hydrological process resulting in decreased recruitment of gravel and large woody debris. The elimination of upstream access coupled with the downstream impacts provided the first steps towards the ultimate demise of healthy anadromous salmonid populations in Stony Creek

Under current operational procedures, storage in East Park Reservoir is maintained as close to the maximum level (51,000 acre-feet) as possible and water levels are kept stable until at least June 1 of each year, unless irrigation demands necessitate releases. When necessary, East Park Reservoir storage is released for irrigation to the minimum storage of 5,000 acre-feet. In the last decade, East Park Reservoir has been maintained close to the maximum storage for 8 of 10 years. Releases for irrigation from East Park Reservoir, if they occur at all, typically occur after June 1 following downstream reservoir storage depletion.

When East Park Reservoir is maintained at a nearly constant full level, this produces a "run of the river" type of operation which mimics the natural hydrograph that would be realized if the dam did not exist (although there are some warming effects and evaporative losses associated with the storage of water in the reservoir). Therefor in years when the reservoir is kept full, there would likely be minimal adverse impacts on salmonid habitat in lower Stony Creek below Black Butte Reservoir.

Rainbow Diversion Dam and the East Park Feeder Canal.
OUWUA proposes to operate the Rainbow Diversion Dam and the East Park Feeder Canal on an as-needed basis to provide supplemental water to East Park Reservoir. As these structures are in an area which is inaccessible to anadromous species, any adverse impacts to listed salmonids from the operations of these structures would be those associated with East Park Reservoir, and are included in the preceding discussion of reservoir operations.

Stony Gorge Dam and Reservoir.
The construction of Stony Gorge Dam on the main stem of Stony Creek in 1928 blocked access by anadromous salmonids to the remainder of the high elevation, cold water habitat in the

Stony Creek watershed above the town of Elk Creek, including all three forks and the many small tributaries which feed Stony Creek. Operation of Stony Gorge Reservoir, including the storage and subsequent release of water, altered the natural flow regime by which juvenile and adult salmonids based their migrations. This altered flow regime also upset the natural hydrological process resulting in decreased recruitment of gravel and large woody debris. The elimination of upstream access coupled with the downstream impacts further reduced Stony Creek's salmonid populations to the point where Stony Creek only "occasionally supported fall-run salmon during the period 1940-1959 in years of early and heavy rains" (Yoshiyama et al. 1995).

Under current operational procedures, storage in Stony Gorge Reservoir is maintained as close to the maximum allowable storage level as possible (38,311 acre-feet during winter flood season and 50,300 acre-feet throughout the rest of the year), unless irrigation demands necessitate releases. When necessary, Stony Gorge Reservoir storage can be released for irrigation to the minimum storage of 7,500 acre-feet. The 1964 Exchange Agreement allows Orland Project water held in Stony Gorge Reservoir to be exchanged with CVP water within Black Butte. Releases of Orland Project water are then made from Black Butte storage instead of from Stony Gorge. Water left in Stony Gorge Reservoir early in the season is available for releases into lower Stony Creek for irrigation later in the summer or early fall.

Comparisons between monthly storage and monthly releases from the three reservoirs in 1996 versus 1997, in conjunction with monthly mean temperatures below Black Butte Dam indicate that the current operational procedures for water releases from the upstream reservoirs provide negligible temperature and flow benefits downstream of Black Butte Dam (Appendix C and D from Reclamation and Corps 2001).

South Diversion Intake and South Canal

OUWUA proposes to operate the South Diversion Intake and South Canal based on demand for the life of the Orland Project. Diversions will typically occur during the months of March to November, but year-round operation may occur dependent on water demands and weather patterns.

The South Diversion Intake and South Canal divert water from an area directly below Black Butte Dam where there is no access for anadromous fish and therefore, no opportunity for listed fish to become entrained in the diversion facility.

In conjunction with the terms of the Exchange Agreement, diversions at the South Diversion Intake results in reductions in upstream reservoir storage. The diversion of this stored water precludes its release into lower Stony Creek where it would otherwise be available to manage for improved salmonid habitat as a surrogate for the habitat lost by the construction of the dams. Additionally, in some years, lower reservoir storage may result in higher release temperatures during late spring through early fall which could potentially affect salmonids incubating or rearing (natal or non-natal) within lower Stony Creek. Due to insufficient historical data, the magnitude of potential impacts to habitat quality resulting from the diversion of this water has not been determined.

Northside Diversion Dam and North Canal

OUWUA proposes to operate the NDD and North Canal according to operations described in the project description for the life of the Orland Project. Diversions will typically occur during the months of March to November although diversions may occur in any month of the year dependant on water demands and weather patterns. Daily operations are limited to a maximum diversion of 130 cfs with a minimum 30 cfs bypass to lower Stony Creek.

As with the South Diversion, diversions into the North Canal may result in reductions of Black Butte storage. The diversion of this stored water provides relatively high, stable flows down to the diversion point, but precludes its continuation down the creek below NDD where it would otherwise be available to manage for improved salmonid habitat as a surrogate for the habitat lost by the construction of the dams. Additionally, in some years, lower reservoir storage may result in higher release temperatures during late spring through early fall which could potentially affect salmonids incubating or rearing (natal or non-natal) within lower Stony Creek. Due to insufficient historical data, the magnitude of potential impacts to habitat quality resulting from the diversion of this water has not been determined.

Adult Migration, Spawning, and Incubation.
In most years, November is the month when water temperatures in Stony Creek cool to the level of preferred temperatures for steelhead adults to immigrate upstream from the Sacramento River into lower Stony Creek to spawn. Upstream migration and spawning will be limited to the reach of Stony Creek below Black Butte Dam due to the impassable nature of this facility. In most years, diversions at NDD have ceased by mid November, prior to the initiation of the steelhead spawning migration in the Central Valley, and do not resume until late March, after the migration period has ended (DFG 1993). During periods of non diversion at NDD, the flashboards are removed from the crest of the dam and a large drum gate on the east side of the dam is often raised to allow creek flows to pass through this section of the dam. The level of obstruction caused by NDD during periods when the flashboards are removed is currently unknown, however a cursory visual inspection of the dam by a NMFS engineer has indicated that the dam is unlikely to pose a significant passage barrier for adult steelhead when the flashboards are removed (John Johnson, NMFS, pers. com. 2000). A comprehensive barrier study to determine the potential for NDD to act as an upstream passage barrier under various flows is being planned by OUWUA.

Any time that there is an overlap of diversion activities (flashboards in place) and the upstream migration of steelhead, passage will be impeded at the NDD due to the lack of a fish ladder at the facility. Adverse effects to steelhead adults would then occur due to complete or temporary blockage at the NDD. Temporary delays in salmonid passage by as little as 3-4 days at migration barriers have been associated with premature mortalities (Andrew and Geen 1960). Complete blockage at the NDD may limit spawning to less desirable spawning and rearing habitat below the diversion dam, thereby reducing reproductive success.

Installation and removal of the NDD flashboards requires that flows be at 30 cfs for 24 hours prior to, and for the four-to-five hours during, the manipulation of the boards. Installation typically occurs in March when irrigation demands begin (average monthly releases from Black Butte range from approximately 90 cfs to 1,750 cfs) and removal typically occurs in November when irrigation demands subside (average monthly releases from Black Butte range from 33 cfs to 224 cfs). Flow fluctuations during installation and removal of the flashboards are likely to impede passage, strand adult and juvenile fish and dewater sections of spawning gravel containing incubating eggs and newly hatched fry. Depending on weather conditions at the time of flashboard installation and removal, the required low flow level may temporarily increase temperature conditions in the creek. Once the flashboards are in place, the NDD becomes a total barrier to upstream passage.

Fry, Juveniles, and Smolts.
If adult steelhead are able to traverse NDD and successfully spawn in the reach above the dam, operation of the NDD and North Canal is likely to adversely affect juveniles hatched above the structure. Throughout much of the irrigation season the majority of the water coming down Stony Creek is diverted into the unscreened North Canal. Therefore, any downstream migrants which attempt to pass below NDD after diversions have begun will have a good chance of being diverted into North Canal where they are very unlikely to survive.

Steelhead spawned and reared above the NDD would likely disperse out of Stony Creek as young-of-the-year instead of smolts since lethal summer temperatures (>75°F occurring as early as June and continuing to October) make it unlikely that a year-round population of steelhead juveniles can survive in lower Stony Creek. Dispersal triggered by temperatures increasing above 65°F may occur beginning in late April to mid-June. Since the NDD and North Canal are typically operated during this time, any steelhead migrating downstream from above the NDD may be entrained into the North Canal or may be blocked from downstream passage by the NDD with subsequent mortality due to high summer temperatures. Juvenile spring-run and winter-run chinook are not expected to rear above the NDD and would not be subjected to entrainment into North Canal.

Since the level of salmonid entrainment into the North Canal is currently unknown, an entrainment evaluation has been included in the proposed fisheries monitoring study identified in the project description. During the pilot stage of this study, limited sampling was conducted at the intake for the North Canal in the spring of 2001 which failed to detect any salmonid entrainment.

Black Butte Dam and Lake

The construction of Black Butte Dam on the main stem of Stony Creek in 1963 blocked access by anadromous salmonids to the remainder of their historic spawning habitat, including all tributaries to Stony Creek, above Black Butte Dam. The only reach that was left accessible to these fish is the lower 24.6 miles of creek which runs along the valley floor between the base of Black Butte Dam and the confluence with the Sacramento River. Historical conditions within this reach provided very poor if any suitable habitat for salmonid spawning and rearing.

High temperatures and low flows created lethal conditions during most summer and early fall months, while high flashy flows carrying heavy sediment loads likely made winter conditions less than optimal for spawning. While the controlled release of stored water from the bottom of Black Butte Reservoir has likely provided some improvements to habitat conditions such as cooler water later into the spring, more consistent flows and less severe flood conditions, there are still many obstacles to the reestablishment of a successful spawning population in Stony Creek.

Black Butte Dam has altered the timing and magnitude of flows as well as sediment transport to lower Stony Creek. Prior to construction of the dam, the channel was a high gradient, bedload dominated system with sharp fluctuations in discharge, where the channel carrying the main flow shifted periodically. Post-dam, the flood peaks have been attenuated, and storm run-off is stored for planned releases. Channel width and sediment transport have been reduced in the upper reaches and significant channel realignment has occurred. The sources of most bedload and suspended sediments have been eliminated by the dam. High volume flood control releases can produce accelerated bank erosion below the dam, which is the only source of coarse bedload within this lower reach. Long-term impacts associated with reservoir operations include the decreased recruitment of spawning gravels, reduced recruitment of woody debris, and encroachment of riparian and non-endemic vegetation into spawning and rearing areas resulting in reduced available habitat (NMFS 1996).

Temperature.
Lower Stony Creek stream temperatures are directly influenced by ambient air temperature, solar radiation, shading, channel geometry, the temperature and volume of water released from Black Butte Reservoir and, to a lesser degree, the other upstream reservoirs. Releases made from Black Butte are made from an outlet located at the bottom of the reservoir, ensuring the coldest temperatures possible. Black Butte Reservoir often stays relatively shallow during the summer months. Vertical temperature profiles indicate that the lake remains thermally unstable or weakly stratified and is easily mixed vertically by winds and diurnal heating and cooling. The waters are warm throughout the depths during the summer (COE 1987). Reclamation's analysis of daily mean temperatures from four monitoring locations on lower Stony Creek from July 1995 to December 1997, indicate that winter temperatures are fairly consistent from year to year. Generally, overall stream temperatures begin to increase between late April and August and begin decreasing in September, reaching optimal spawning temperatures again in November. Monthly mean temperatures traveling downstream from just below Black Butte Dam to St. John's gage (CM 7) increased between 1.9 to 7.6 degrees during the summer and decreased between 1.2 and 3.2 degrees during the winter

Flood Control Operations
Ramping criteria for flood control releases from Black Butte Reservoir is described in the Corps water control plan as follows: the rate of change for an increase shall not be more than 2000 cfs in any 2 hour interval. When an existing release is between 15,000 cfs and 5,000 cfs, outflow shall be reduced in 1,000 cfs increments with no release sustained for less than 2 hours. When an existing release is between 5,000 cfs and 50 cfs, outflow shall be reduced in 500 cfs increments with no release sustained for less than 2 hours. As mentioned above, flows

in Stony Creek may increase and decrease rapidly in response to Black Butte flood control or safety of dams criteria. Stranding of chinook and steelhead may occur when water levels drop quickly and fish are either left totally exposed in dewatered areas or isolated in wetted areas that are no longer connected to the creek. If no additional high flow events follow within a short period of time, isolated fish may be lost to predation, lethal water temperature conditions, or desiccation.

The COE intends to operate Black Butte Dam as it has since construction, for the life of the project, following the approved Water Control Plan. Any flood control releases will follow the Water Control Plan, while conservation and other releases will be determined by Reclamation. The current operating protocol for Black Butte Dam for flood control prevents the release of consistent flows once a major storm has occurred and the Water Control Plan is requiring flood releases. Some pre-flood releases in the fall can be made by Reclamation, under certain weather conditions, when the flood control space is not encroached. Typically, once flood releases begin in the fall under the direction of the COE, Reclamation no longer manages Black Butte for CVP releases, until such time in the spring as is jointly determined that the lake is out of flood control.

During October through April, chinook and/or steelhead adults may immigrate upstream from the Sacramento River into lower Stony Creek. Upstream migration and spawning is limited to the reach of Stony Creek below Black Butte Dam due to the impassable nature of this facility.

Flows in lower Stony Creek greater than 100-200 cfs released from Black Butte Dam are expected to provide adequate upstream passage conditions for fall-run chinook, late fall-run chinook, and steelhead (Puckett 1969; Reclamation 1998). Flows reaching this magnitude typically occur from November through May, usually inconsistently. Predicted temperature conditions are within the range of preferred spawning temperatures from approximately early November to mid-to late April.

During the winter/early spring season, large flow releases from Black Butte Dam to lower Stony Creek may be required for short durations by COE under the current flood control and safety of dams criteria. A representative sample of daily data for Black Butte outflow obtained from the COE for water years 1996 to 1998 shows that day to day flow fluctuations due to flood control operations can be large, on the order of 100-1300 percent of the prior day's flow, and range in magnitude from several hundred to approximately 6,000 cfs of change in a single day. The magnitude and frequency of these flow fluctuations have the potential to cause major adverse impacts to salmonids including stranding of adult and juvenile fish, scouring and/or dewatering of spawning areas and severe bank erosion.

Black Butte Dam Powerplant

The Black Butte Powerplant is operated opportunistically to take advantage of releases which are otherwise required for flood control or diversions. Flows are not released nor regulated solely for hydropower generation. The intake for the power plant takes water from the base of the dam and therefore provides the coldest water available from the reservoir. The powerplant uses only the force of the water to turn the turbines and generate hydropower, and water that is used is subsequently released to lower Stony Creek below Black Butte Dam. Temperature measurements taken at the powerplant tailwaters before release downstream indicate the powerplant does not significantly increase water temperatures downstream. Due to the eventual return of all water used at the powerplant to the creek and the method of power generation, powerplant operations do not affect the amount of flow released into lower Stony Creek from Black Butte Dam and have a somewhat negligible effect on the temperatures of flow releases. Therefore, powerplant operations are not likely to impact salmonids in lower Stony Creek.

Constant Head Orifice Rediversion

The CHO is operated based on demands from April 1 through May 15 and from September 15 through October 29, up to a maximum of 38,293 acre-feet per year. Diversions at the CHO may result in reductions of Black Butte storage. The diversion of this stored water provides increased flows down to the CHO but precludes its continuation down the creek below the CHO where it would otherwise be available to manage for improved salmonid habitat as a surrogate for the habitat lost by the construction of the dams. Additionally, in some years, lower reservoir storage may result in higher release temperatures during late spring through early fall which could potentially affect salmonids incubating or rearing (natal or non-natal) within lower Stony Creek. Due to insufficient historical data, the magnitude of potential impacts to habitat quality resulting from the diversion of this water has not been determined.

Adult Migration, Spawning, and Incubation.
CHO operations in April and October occur during potential upstream spawning immigration of steelhead and fall-run adults, respectively. In most years the likelihood is low that steelhead or fall-run will be migrating at these times into Stony Creek since March is the end of peak migration for steelhead, and flow and temperature conditions within the creek during October are typically unsuitable for adult chinook. Any adults traveling upstream during these times may be adversely affected due to temporary passage delays and increased turbidity associated with CHO operations. Temporary upstream passage delays may occur during the construction of the CHO berm in the spring and during operation of the CHO diversion. Culverts are placed within the berm during construction to minimize passage problems during operations. Temporary increases in turbidity levels may occur during the construction of the CHO berm. The berm is washed out each winter by high flows from Black Butte Dam. Entrainment of adults into the TCC will be monitored during the proposed fisheries study but is thought to be unlikely due to timing of operation and design of the facility.

Fry, Juveniles, and Smolts.
Steelhead juveniles spawned and reared in lower Stony Creek would likely disperse out of the creek as young-of-the-year instead of smolts since high summer temperatures make it unlikely that a year-round population of steelhead juveniles can exist in lower Stony Creek. Dispersal may be triggered by increasing water temperatures which can exceed 65°F beginning as early as late April. Since the unscreened CHO may be operated during this time, any steelhead migrating downstream from above the CHO may be entrained into the TCC or may be blocked

from downstream passage by the temporary CHO berm with subsequent mortality due to high summer temperatures. In addition, any non-natal rearing steelhead juveniles located above the CHO would likely disperse out of the creek by the same temperature triggers as natal steelhead and be subject to the same adverse effects. In order to minimize downstream passage problems, culverts are placed within the temporary berm to facilitate passage. Also, adverse effects to juveniles are reduced through implementing conditions of the SWRCB permit (e.g., maintaining bypass flows below the CHO, slowly ramping down flows, and providing a fish distribution flow prior to rediversion).

Based on emigration patterns of fall-run and late fall-run chinook in the upper Sacramento River which are dependent on hydrologic conditions, fall-run and late fall-run chinook juveniles and smolts may emigrate downstream and out of Stony Creek from January through mid-June, and from late April to late December, respectively. As with steelhead, late fall-run spawned and reared above the CHO would likely disperse out of Stony Creek as young-of-the-year and dispersal would be triggered by rising temperatures. Any fall- or late fall-run chinook migrating downstream from above the CHO may be entrained into the TCC or may be blocked from downstream passage by the CHO berm with subsequent mortality due to high summer temperatures. In addition, any non-natal rearing fall-, late fall-, spring-, or winter-run chinook juveniles located above the CHO would likely disperse out of the creek by the same temperature triggers as natal chinook and be subject to the same adverse effects and associated mitigation measures.

Operation of the unscreened CHO diversion during April 1 through May 15 has the potential to adversely affect some juvenile steelhead and chinook salmon through direct entrainment. The magnitude of entrainment or blockage is currently unknown, however, Reclamation proposes to include an entrainment evaluation within the proposed fisheries monitoring study identified as a part of the proposed action

Fisheries Monitoring

From November 1, 2000 to November 1, 2003, Reclamation proposes to conduct a year-round fisheries monitoring study on lower Stony Creek.

<u>Adult Migration, Spawning, and Incubation</u>.
Spawning surveys during the fall and early winter months will be conducted according to established DFG protocols which are expected to have negligible effects on migrating and spawning adults, and incubating eggs. Seining surveys conducted during potential incubation periods in the spring will minimize adverse effects by avoiding known redds. Electrofishing surveys will be conducted after fry emergence and before adult migrants have arrived in the creek, therefore, will have no effect on adults or incubating eggs or sac-fry.

<u>Fry, Juveniles, and Smolts</u>.
In previous studies, total juvenile chinook captured over varying sampling periods ranged from 4 to 685 and juvenile steelhead ranged from 4 to 53. Based on the average of chinook captured per day (e.g, 35) and the proposed level of sampling for Reclamation's monitoring

study (e.g., 240 days per year; includes number of actual days multiplied by different types of sampling gears), it is anticipated that up to 8,400 juvenile chinook may be captured each sampling year with no more than 5% mortality rate (e.g., <420 chinook). Based on the maximum total number of steelhead captured per year (e.g., 53; maximum total number used due to the small data set regarding steelhead) and assumption that the proposed level of sampling for Reclamation's monitoring study will be higher than previous sampling (approximately 3 times), it is expected that up to 159 juvenile steelhead may be captured each sampling year with no more than a 5% mortality rate (e.g., <8 steelhead). Although lower Stony Creek salmonid populations are thought to be quite small, the expected capture of juvenile chinook salmon and steelhead is likely to have little, if any, effect on lower Stony Creek salmonid populations due to the low numbers captured and the adherence to sampling/handling protocols that minimize stress and harm. There are no plans to purposely sacrifice or retain any salmonids during the fisheries monitoring study..

Synthesis of Effects

The greatest adverse effect associated with Stony Creek water management operations is the complete blockage of access by anadromous species to their historical spawning and rearing habitat above Black Butte Dam. Because this historic habitat is no longer accessible, chinook salmon and steelhead are relegated to a small reach of the creek containing only marginal habitat that was not historically used to any great extent by these species. This makes these fish particularly vulnerable to the water management operations of the Corps and Reclamation. These Federal agencies, through the storage and release of flows, control the quantity and quality of the small amount of remaining habitat on Stony Creek.

The alteration of the natural hydrologic cycle due to upstream dam operations on Stony Creek has the potential to adversely affect all life stages of steelhead, as well as juvenile spring-run and winter-run chinook salmon. Reservoir operations resulting in large scale flow fluctuations could cause adverse effects such as redd scouring or juvenile stranding. Extended periods of low flow releases can result in increased temperatures and reduced habitat availability.

Direct entrainment of juvenile steelhead may occur within the North Canal and CHO Diversions and juvenile spring-run and winter-run chinook rearing in Stony Creek may be entrained in the CHO Diversion. The diversion of water out of Stony Creek for consumptive purposes reduces flows below those diversions which results in increased water temperatures and reduced quality and quantity of critical habitat.

The proposed fisheries monitoring study is expected to produce minor, short term impacts such as harassment and capture (with prompt release) of salmonids.

Impacts on Evolutionarily Significant Unit Survival and Recovery

In examining the potential impacts of Stony Creek water management operations on the listed ESUs, NMFS must determine whether or not those impacts are likely to reduce the numbers, reproduction or distribution of these fish in such a way that their likelihood of recovery and survival within the action area is appreciably diminished, and if so, how those local reductions are likely to affect the overall population's likelihood of survival and recovery throughout the ESU.

Sacramento winter-run and Central Valley spring-run ESUs
With regards to winter-run and spring-run chinook salmon, it is clear that project impacts on Stony Creek are unlikely to affect either reproduction or distribution of these ESUs as there are no spawning populations of either ESU remaining in Stony Creek. The fact that juvenile winter and spring-run chinook salmon have been documented rearing in Stony Creek means that certain impacts of the water management operations such as sustained low flows, flow fluctuations and unscreened water diversions could cause a reduction in the numbers of fish that have chosen Stony Creek as rearing habitat. However, the majority of juvenile salmon collected in Stony Creek have been found within the lower two miles of the creek (Maslin and McKinney 1994; Loggins et al. 1997) where they are not exposed to water diversions and they are likely to have the ability to escape to the Sacramento River when conditions in Stony Creek become unfavorable. Therefore it is likely that very few of the fish that use Stony Creek as a rearing area are actually harmed or killed by the adverse effects associated with water management operations.

In estimating the effect of the loss of a small proportion of Stony Creek juveniles on the broader Central Valley populations of these ESUs, it is important to note that the poor habitat conditions found in Stony Creek (low flows, high temperatures and poor SRA habitat) make it unlikely that this creek is used as non-natal rearing habitat by a significant proportion of the juvenile populations of these ESUs. The injury and death of a small number of juvenile chinook salmon is unlikely to result in detectable reductions in the number, reproduction, or distribution of winter and spring-run chinook salmon given the large fluctuations in juvenile survival rates experienced by the populations annually. As a result, NMFS finds that it is not reasonable to expect that these juvenile losses will reduce the likelihood of survival and recovery of the Sacramento River winter-run chinook salmon or the Central Valley spring-run chinook salmon.

Central Valley steelhead
Although steelhead spawning has not been documented in Stony Creek in recent years, there is now access to suitable spawning habitat for steelhead in the creek, following the removal of the GCID berm, and it is reasonable to assume that water management operations can and will have an effect on steelhead numbers, reproduction and distribution within Stony Creek. The severity of the adverse impacts produced by current operations will vary from year to year and season to season dependent on hydrologic conditions, irrigation demands and flood control requirements. It is likely that in years when operations produce extreme flow fluctuations, blockage or delay in migration, extended low flow periods and other such impacts, steelhead numbers, reproductive success and distribution will be reduced. If these severe conditions occur on a regular basis, the likelihood of survival and recovery of the local steelhead population would be appreciably reduced.

The potential for project effects to appreciably reduce the likelihood of survival and recovery of the local steelhead population in Stony Creek requires that we must next determine the importance of this population to the viability of the overall Central Valley ESU. This importance can be measured by the level of contribution that the Stony Creek population makes to the numbers, genetic diversity and resilience of the greater ESU population.

It is likely that prior to the permanent removal of the GCID crossing, favorable conditions for steelhead spawning and fry survival only occurred on an occasional basis, and it is unlikely that a significant sustained population could have been established. The longstanding access problem caused by the GCID canal crossing, along with all of the other effects of current water management operations on Stony Creek make it very unlikely that any current population of steelhead on Stony Creek is large enough or genetically distinct enough to contribute significantly to the Central Valley ESU. Based on the likely low value of the Stony Creek population to the overall diversity and resilience of the Central Valley steelhead ESU, NMFS finds that it is not reasonable to expect that reductions in the likelihood of survival and recovery of the local population will result in reductions in the likelihood of survival and recovery of the ESU.

Critical Habitat

Habitat conditions in lower Stony Creek below Black Butte Dam have always been marginal in terms of the ability to support spawning populations of chinook salmon and steelhead. The location on the valley floor and natural hydrologic conditions created an environment that was likely too hot and dry to serve as anything other than a migratory corridor for these fish to access the more suitable habitat found in the upper reaches of the watershed. The controlled release of relatively cool water out of Black Butte Dam has improved the potential for this reach to serve as spawning and rearing habitat, although that improvement is relatively limited and the habitat remains somewhat marginal.

While the water management operations conducted on lower Stony Creek have been shown to reduce the quality and quantity of critical habitat in this area (water temperatures, flow levels, migrational barriers within the lower creek), the small amount of habitat available in lower Stony Creek and the incremental level of degradation likely to occur do not appear to degrade the functions for which the habitat is currently used. Proposed operations will maintain the value of the habitat and are not expected to diminish the current levels or types of habitat use by salmonids. As a result, NMFS expects that the proposed operations are not likely to diminish the value of critical habitat in lower Stony Creek for the survival and recovery of spring-run chinook salmon and steelhead, or diminish the value of critical habitat within the overall designation. Lower Stony Creek water management operations are not expected to impact critical habitat for Sacramento River winter-run chinook salmon.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future

Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Non-Federal actions that may affect lower Stony Creek include agricultural practices, water withdrawals/diversions, mining, and State or privately sponsored habitat restoration activities. Diversions and ground-water pumping may result in entrainment of individuals into unscreened diversions and may result in depleted creek flows that are necessary for migration, spawning, rearing, and sediment transport. Mining operations in the area may adversely affect water quality, gravel recruitment, riparian function, and stream productivity. Habitat restoration projects may have short-term negative affects associated with instream construction work, but the long term goals would be to benefit listed species.

CONCLUSION

After reviewing the current status of endangered Sacramento River winter-run chinook salmon, threatened Central Valley spring-run chinook salmon and Central Valley steelhead, the environmental baseline for the action area, the effects of current lower Stony Creek water operations and all other cumulative effects, it is NMFS' biological opinion that lower Stony Creek water operations are not likely to jeopardize the continued existence of these species, and is not likely to destroy or adversely modify designated critical habitat for these species over the next three years.

INCIDENTAL TAKE STATEMENT

Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, spawning, rearing, feeding, migrating, and sheltering (50 C.F.R.§ 222.106; 64 Fed. Reg. 60727). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the proposed action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are nondiscretionary, and must be undertaken by the Agencies so that they become binding conditions of any permits issued or project descriptions, as appropriate, for the exemption in section 7(o)(2) to apply. The Agencies have a continuing duty to regulate the activities covered by this incidental take statement. If the Agencies fail to assume and implement the terms and conditions, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Agencies must report the progress of the action and its impact on the species to NMFS as specified in the incidental take statement. (50 CFR §402.14(I)(3))

Amount or Extent of Take

There are several aspects of the proposed action which have the potential to take listed species. The actual numbers of individuals likely to be taken can be estimated for certain aspects of the project while for others it can not. With regards to the entrainment of fish into the irrigation canals as well as the capture of fish during the proposed fisheries monitoring activities, previously collected data is available from which to derive an estimate of take likely to occur from these activities. Data collected during previous studies and sampling efforts in lower Stony Creek (Brown 1995, Maslin and McKinney 1994, Loggins et al. 1997, Reclamation Unpublished Data 2001) has been analyzed and applied to the level and intensity of sampling and entrainment monitoring proposed for this project. This analysis indicates that an annual total of; 20 Sacramento River winter-run chinook salmon; 80 Central Valley Spring-run chinook salmon; and 160 Central Valley steelhead trout are likely to be captured through the combination of entrainment monitoring at the irrigation diversions and the other sampling associated with the fisheries monitoring study. Every effort will be made to insure that all fish captured during these activities are kept in good condition and will be released back into the creek following data collection. The estimate for actual mortality of captured fish is 5% or less of those captured.

There are several other aspects of the proposed water management operations which can cause the incidental take of listed species through extreme flow fluctuations, insufficient releases which do not maintain suitable habitat conditions within lower Stony Creek, and the installation, operation and maintenance of diversion structures. The take associated with these activities is likely to occur in the form of entrainment into agricultural diversions, dewatered redds, scoured redds, delayed or blocked migration due to low flows and/or structural impediments (diversion structures), isolation and stranding of fish due to flow fluctuations and reduced survival and fecundity due to unfavorable habitat conditions. It is impossible to estimate the number of listed fish likely to be taken as a result of these impacts due to many unpredictable variables such as population size and timing of use by the various life stages of the listed species in Stony Creek and weather conditions/precipitation levels which will influence the frequency, timing and magnitude of flow fluctuations as well as water temperatures and habitat availability and quality.

Because of the unpredictable nature of the annual level of take likely to be caused by these aspects of Stony Creek water management operations, NMFS has determined that the take of listed species may be measured through compliance with the terms and conditions of this incidental take statement along with other plans and guidelines currently in place which govern water management operations on lower Stony Creek (the Corps' Water Control Plan and Flood Control Diagram, and Reclamation's Lower Stony Creek Fish, Wildlife and Water Use Management Plan). Any action that is not in compliance with the terms and conditions of this statement or these other guidelines will be considered to have exceeded anticipated take levels, triggering the need to reinitiate consultation on the project.

Effect of the Take

The annual alteration of the natural hydrologic cycle due to reservoir operations on Stony Creek has the potential to take all life stages of steelhead as well as juvenile spring-run and winter-run chinook salmon. Reservoir operations resulting in large scale flow fluctuations can take listed fish and viable eggs by resulting in redd scouring or juvenile stranding. Take can also be expected to occur when extended periods of low flow releases result in increased temperatures and reduced habitat availability.

Direct entrainment of juvenile steelhead may occur within the North Canal and CHO Diversions. Also, juvenile spring-run and winter-run chinook rearing in Stony Creek may be entrained in the CHO Diversion. The diversion of water out of Stony Creek for consumptive use reduces flows below those diversions which results in increased water temperatures and reduced quality and quantity of critical habitat.

The proposed fisheries monitoring study is expected to take a small number of individuals in the form of harassment and capture (with prompt release) of listed salmonids.

In this biological opinion, NMFS has determined that the level of anticipated take is not likely to jeopardize the continued existence of listed Sacramento River winter-run chinook salmon, Central Valley spring chinook, or Central Valley steelhead or to result in the destruction or adverse modification of critical habitat over the three year time period covered by this incidental take statement.

Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of Sacramento winter-run chinook salmon, Central Valley spring chinook salmon and Central Valley steelhead:

1. Reclamation shall seek to minimize the impacts to listed species associated with the diversion of water from Stony Creek by providing upstream passage past diversion structures during steelhead adult migration periods and minimizing the impacts of entrainment of juvenile salmonids into irrigation canals.

2. The Corps of Engineers shall modify its flood release ramping rates to minimize the adverse effects of flow fluctuations on incubating eggs as well as juvenile and adult anadromous salmonids in Stony Creek.

3. Reclamation and the Corps shall analyze the feasibility of increasing releases from Black Butte Dam to provide a minimum stream flow of 100 to 150 cfs past the lowest active diversion point (NDD or the CHO) during cold water periods (i.e. October through May) to provide reliable conditions for successful spawning and rearing within this section of critical habitat

Terms and Conditions

Reclamation and the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. Reclamation shall seek to minimize the impacts to listed species associated with the diversion of water from Stony Creek by providing upstream passage past diversion structures during steelhead adult migration periods and minimizing the impacts of entrainment of juvenile salmonids into irrigation canals.

   A) A feasibility study shall be conducted to determine the need for, and practicality of a temporary fish ladder at the North Diversion Dam. This study should include;

      i A barrier analysis of the dam to determine the ability of adult salmonids to pass the dam under varying flow conditions during periods when the flash boards have been removed.

      ii A comparison of potential water diversion periods to upstream salmonid migration periods to determine the level of overlap and potential impacts to upstream migrants.

      iii An analysis of the most suitable design, placement and operation of a temporary ladder at this site.

      A final report on this study shall be submitted to NMFS within one year of the issuance of this final biological opinion. If the feasibility study indicates a fish ladder is necessary and feasible, a temporary fish ladder shall be constructed and operational at the North Diversion Dam by October 1, 2004.

   B) OUWUA's ongoing study examining the potential for complete removal of NDD will determine the length of time that any temporary ladder shall be operated. If the study finds that the project is feasible and should move forward to the design and construction phase, the temporary ladder shall remain in placed until the dam is removed. If the study shows that the project is infeasible and should not go forward, and a fish ladder has been found to be beneficial, then plans for construction of a permanent state of the art fish ladder shall immediately commence.

   C) In conjunction with the on-going fisheries monitoring program, a monitoring/fish salvage operation will be immediately implemented which will capture any salmonids that may be entrained into the North Canal. All fish captured shall be identified, enumerated and immediately released into Stony

Creek below NDD. This operation will be maintained at all times the diversion is operated during potential salmonid outmigration periods.

D) If removal of NDD is found to be infeasible, and a permanent fish ladder is found to be necessary, a state-of-the-art fish screen shall be constructed in conjunction with the new fish ladder.

E) Reclamation shall continue to diligently pursue a solution to water delivery shortages at the Tehama Colusa Canal which will eliminate the impacts of CHO diversions on Stony Creek fisheries. Those impacts include temporary blockage of upstream and downstream migration, entrainment of juveniles into the TCC, and depletion of water from lower Stony Creek.

F) In conjunction with the on-going fisheries monitoring program, Reclamation will develop and implement a monitoring/fish salvage operation capable of capturing any salmonids that may be entrained into the TCC throughout CHO operations. All fish captured shall be identified, enumerated and immediately released into Stony Creek below the CHO.

2. The Corps of Engineers shall modify its flood release ramping rates to minimize the adverse effects of flow fluctuations on incubating eggs as well as juvenile and adult anadromous salmonids in Stony Creek.

A) The COE shall implement the following changes to the protocols for flood releases[1] from Black Butte Reservoir for all storm events which are forecasted to cause encroachment into the flood space of less than 80%. For very large storm events which are forecasted to cause encroachment into the flood space of 80% or more, the protocols for increasing releases shall revert back to the existing rates of change.

The rates of change for increasing flood releases shall be as follows:

i. When existing flood release is between minimum flow and 1,000 cfs, releases will be increased by no more than 500 cfs/hour. During small storms (those forecasted to cause encroachment into the flood space of less than 25%.) keep release increases at or below 250 cfs/hour increments.

ii. When existing flood release is between 1,000 cfs and 15,000 cfs, releases will be increased by no more than 1,000 cfs/hour.

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[1] All releases are expected to be within +- 5% those targeted.

The rate of change for decreasing releases shall be as follows:

i. When existing flood release is between 15,000 cfs and 5,000 cfs, releases will be decreased by no more than 500 cfs/hour with no release sustained for less than one (1) hour.

ii. When existing flood release is between 5,000 cfs and 1,000 cfs, releases will be decreased by no more than 250 cfs/hour with no release sustained for less than one (1) hour.

iii. When existing flood release is between 1,000 and 100 cfs, releases will be decreased using one or both of the following guidelines, whichever is slower:

a. If inflow into Black Butte is decreasing, then reduce releases at approximately the same rate as the inflow is receding. However if inflows are steady or increasing, and the allowable conservation pool is also increasing, decrease releases by approximately 20% of inflow/day

or

b At or near dark or at the end of the work day, decrease releases by approximately 15%, and before or near dawn or at the beginning of the work day, decrease releases by an additional 15%.

iv. When existing flood release is at or below 100 cfs, releases will be decreased in approximately 10 cfs/hour increments.

B) Reclamation shall, as part of its Fisheries Monitoring Program, closely monitor habitat conditions and stranding potential associated with changing stream flows occurring while the Corps is implementing the new ramping rates called for in this opinion.

3. Reclamation and the Corps shall analyze the feasibility of providing a minimum stream flow of 100 to 150 cfs past the lowest active diversion point (NDD or the CHO) during cold water periods (i.e. October 1 through May 31) to provide reliable conditions for successful spawning of steelhead within this section of their critical habitat

A) To determine the feasibility of increasing the minimum stream flow to provide suitable fisheries habitat within lower Stony Creek, Reclamation shall analyze the potential impacts to water deliveries from the annual devotion of 10,000 and 20,000 acre-feet of water from the Stony Creek system to fisheries recovery flows in lower Stony Creek. A report on this analysis should be submitted to NMFS within one year of the issuance of this final biological opinion.

B) To determine the feasibility of increasing the minimum stream flow to provide suitable fisheries habitat within lower Stony Creek, the Corps shall analyze the potential impacts to flood control from increasing the encroachment baseline for Black Butte Reservoir by 5,000 acre feet and 10,000 acre feet. A report on these analysis should be submitted to NMFS within one year of the issuance of this final biological opinion.

Both of the above mentioned analysis as well as other updates and reports required by these terms and conditions shall be submitted to:

Office Supervisor
Sacramento Area Office
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300
Sacramento, CA 95814
FAX: (916) 930-3629
Phone: (916) 930-3604
email: Michael.Tucker@noaa.gov

If either agency, in their operation of Stony Creek water management, violates any of the terms and conditions set forth in this incidental take statement, then the level of incidental take anticipated in this biological opinion will be exceeded. Such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. If such a situation arises, the Agencies must immediately notify NMFS to provide an explanation of the increase in take and review with NMFS the need for reinitiation of consultation and modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on a listed species or critical habitat, to help implement recovery plans, or to develop information.

1. Reclamation and the Corps should support and promote habitat restoration activities in lower Stony Creek, including the local land owner based efforts to restore healthy riparian habitat along the lower creek.

2. Reclamation should, in its pursuit of a solution to the fish passage/water supply problems at Red Bluff Diversion Dam, give a high priority to those alternatives which provide for all necessary water to be diverted from the main stem of the Sacramento River, thereby eliminating the need for CHO diversions from Stony Creek and reducing the irrigation water burden on the Stony Creek system.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the actions outlined in the proposed lower Stony Creek Water Management Program. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take authorized in the accompanying incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in this opinion; (3) the action is subsequently modified in a manner that causes an effect on the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

Additionally the total time period covered under this biological opinion shall not exceed three years from the date of its issuance. At that time all provisions of this biological opinion shall expire, including any coverage for incidental take. The Corps and Reclamation will then be required to reinitiate formal consultation on the effects of lower Stony Creek water management operations on any species which may be listed at that time. The reason for the establishment of this time limit is that several studies, analyses and other processes are currently, or soon will be, underway which will provide extensive new information on the impacts and potential solutions to those impacts associated with lower Stony Creek water management operations. The studies which are expected to provide this important information include the fisheries monitoring study proposed by Reclamation, the fish passage/water supply study underway at Red Bluff Diversion Dam and the Stony Creek water supply and flood risk analysis called for as terms and conditions of the following incidental take statement.

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Enclosure 2.

<u>Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA)</u>

ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS[1]
Lower Stony Creek Water Management

I. IDENTIFICATION OF ESSENTIAL FISH HABITAT

The geographic extent of freshwater essential fish habitat (EFH) for the Pacific salmon fishery is proposed as waters currently or historically accessible to salmon within specific U.S. Geological Survey hydrologic units (Pacific Fisheries Management Council 1999). For the Sacramento River watershed, the aquatic areas identified as EFH for chinook salmon are within the hydrologic unit map numbered 18020109 (Lower Sacramento River) and 18020112 (upper Sacramento River to Clear Creek). The upstream extent of Pacific salmon EFH in Stony Creek is to Black Butte Dam, at Creek Mile (CM) 24.6.

EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat, "waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means habitat required to support a sustainable fishery and a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

The attached biological opinion thoroughly addresses the two species of chinook salmon potentially affected by the proposed action, which are listed under the Endangered Species Act (ESA) as well as the MSFCMA. These are the Sacramento River winter-run chinook salmon (*Oncorhynchus tshawytscha*) and Central Valley spring-run chinook salmon (*O. tshawytscha*). Therefore, this EFH consultation will concentrate most heavily on the Central Valley fall/late fall-run chinook salmon (*O. tshawytscha*) which is also covered under the MSFCMA although not listed under the ESA.

The Sacramento, Feather, Yuba, American, Cosumnes, Mokelumne, Stanislaus, Tuolumne,

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[1]The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) set forth new mandates for the National Marine Fisheries Service (NMFS) and federal action agencies to protect important marine and anadromous fish habitat. Federal action agencies which fund, permit, or carry out activities that may adversely impact EFH are required to consult with NMFS regarding potential adverse effects of their actions on EFH, and respond in writing to NMFS "EFH Conservation Recommendations." The Pacific Fisheries Management Council has identified essential fish habitat (EFH) for the Pacific salmon fishery in Amendment 14 to the Pacific Coast Salmon Fishery Management Plan.

Merced, and San Joaquin Rivers, and many of their tributaries, support wild populations of the fall/late-fall chinook salmon ESU. However, forty to fifty (40-50) percent of spawning and rearing habitats once used by these fish have been lost or degraded. Fall/late-fall run (herein "fall-run") chinook salmon were once found throughout the Sacramento and San Joaquin River drainages, but have suffered declines since the mid-1900s as a result of several factors, including commercial fishing, blockage of spawning and rearing habitat, water flow fluctuations, unsuitable water temperatures, loss of fish in overflow basins, loss of genetic fitness and habitat competition due to straying hatchery fish, and a reduction in habitat quality.

All chinook salmon in the Sacramento/San Joaquin Basin are genetically and physically distinguishable from coastal forms (Clark 1929). In general, San Joaquin River populations tend to mature at an earlier age and spawn later in the year than Sacramento River populations. These differences could have been phenotypic responses to the generally warmer temperature and lower flow conditions found in the San Joaquin River Basin relative to the Sacramento River Basin. There is no apparent difference in the distribution of marine coded wire tag (CWT) recoveries from Sacramento and San Joaquin River hatchery populations, nor is there genetic differences between Sacramento and San Joaquin River fall-run populations (based on DNA and allozyme analysis) of a similar magnitude to that used in distinguishing other ESUs. This apparent lack of distinguishing life-history and genetic characteristics may be due, in part, to large-scale transfers of Sacramento River fall-run chinook salmon into the San Joaquin River Basin.

Central Valley fall-run chinook salmon are often caught in monitoring efforts throughout the basin which are primarily focused on studying winter-run and spring-run chinook salmon. However, despite many diverse sources of information, there has been little effort at coordinating data to attain population estimates, or to determine the viability of the wild fall-run populations remaining in the Central Valley. A general increase in salmon runs in the Sacramento River since 1990 may be attributable to several factors including, increased water supplies following the 1987-1992 drought, stricter ocean harvest regulations, and fisheries restoration actions throughout the Central Valley. This population increase has likely carried over to the wild fall-run chinook salmon population as well. Chinook salmon production is supplemented by fall and late-fall chinook salmon reared at the U.S. Fish and Wildlife-operated Coleman Fish Hatchery on the Sacramento River; and California Department of Fish and Game-operated Feather River Hatchery on the Feather River, Nimbus Hatchery on the American River, and Mokelumne Hatchery on the Mokelumne River (all fall-run chinook salmon). There are indications that fall-run populations are generally stable or increasing, but it is unclear if natural populations are self-sustaining because of high hatchery production. Concern remains over impacts from high hatchery production and harvest levels, although ocean and freshwater harvest rates have been recently reduced.

Although little information has been documented on fall/late-fall run chinook salmon spawning in Stony Creek since the construction of Black Butte Dam, there has been sporadic documentation of spawning and juvenile rearing within the creek. Spawning surveys conducted by CDFG in the winter of 1981-82 estimated 384 adult fall-run chinook salmon spawning in

Stony Creek (Reavis, 1983). Current surveys conducted by CDFG during the fall and winter of 2000-01 have documented successful chinook salmon spawning in Stony Creek during a very dry year. Although no adult salmon were actually seen during the highly limited surveys, redds were located and newly emergent fry were collected at several locations throughout the lower 15 miles of the creek (pers. com. Charles Brown, 3/5/01). Several other sampling efforts conducted over the past 20 years have captured juvenile fall-, spring-, and winter-run chinook salmon, mostly near the confluence with the Sacramento River (Maslin and McKinney 1994, Brown 1995, Reavis 1983). In addition, juvenile chinook salmon have been collected as far upstream as CM 15.5 (Reclamation sponsored sampling by DFG 2000). It is suspected that the majority of juveniles found within Stony Creek near the confluence with the Sacramento River in recent years represent non-natal rearing populations. However, spawning has been documented in Stony Creek during this period and there is insufficient data to determine the origin of the captured juveniles. Comprehensive sampling efforts to ascertain chinook salmon spawning and juvenile production within Stony Creek are under way to clarify these uncertainties.

Life History and Habitat Requirements

Central Valley fall-run chinook are "ocean-type", entering the Sacramento and San Joaquin Rivers from July through April, and spawning from October through December. Peak spawning occurs in October and November (Reynolds et al. 1993). Chinook salmon spawning generally occurs in swift, relatively shallow riffles or along the edges of fast runs at depths greater than 6 inches, usually 1-3 feet to 10-15 feet. Preferred spawning substrate is clean loose gravel. Gravels are unsuitable for spawning when cemented with clay or fines, or when sediments settle out onto redds reducing intergravel percolation (NMFS 1997).

Egg incubation occurs from October through March, and juvenile rearing and smolt emigration occurs from January through June (Reynolds et al. 1993). Shortly after emergence from their gravel nests, most fry disperse downstream towards the Delta and estuary (Kjelson et al. 1982). The remainder of fry hide in the gravel or station in calm, shallow waters with bank cover such as tree roots, logs, and submerged or overhead vegetation. These juveniles feed and grow from January through mid-May, and emigrate to the Delta and estuary from mid-March through mid-June (Lister and Genoe 1970). As they grow, the juveniles associate with coarser substrates along the stream margin or farther from shore (Healey 1991). Along the emigration route, tributary streams are used as rearing habitat. These non-natal rearing areas are highly productive micro-habitats providing abundant food and cover for juvenile chinook salmon to grow to the smolt stage. Smolts are juvenile salmonids that are undergoing a physiological transformation that allows them to enter saltwater. These smolts generally spend a very short time in the Delta and estuary before entry into the ocean.

In contrast, the majority of fry carried downstream soon after emergence are believed to reside in the Delta and estuary for several months before entering the ocean (Healey 1980, 1982; Kjelson et al. 1982). Principal foods of chinook while rearing in freshwater and estuarine environments are larval and adult insects and zooplankton such as *Daphnia,* flys, gnats, mosquitoes or copepods (Kjelson et al. 1982), stonefly nymphs or beetle larvae (Chapman and Quistdorff 1938) as well as other estuarine and freshwater invertebrates. Whether entering the Delta or estuary as a fry or juvenile, fall-run chinook depend on passage through the Sacramento-San Joaquin Delta for access to the ocean.

The fish rear in calm, marginal areas of the river, particularly back eddies, behind fallen trees, near undercut tree roots or over areas of bank cover, and emigrate as smolts from April through June. They remain off the California coast during their ocean migration

II. PROPOSED ACTION

The proposed action is described in the *Description of the Proposed Action* section of the preceding Biological Opinion for the endangered Sacramento River winter-run chinook salmon, threatened Central Valley steelhead, and Central Valley spring-run chinook salmon ESUs.

III. EFFECTS OF THE PROJECT ACTION

The greatest adverse effect on fall-run chinook salmon associated with Stony Creek water management operations is the complete blockage of access to a large portion their historical spawning and rearing habitat above Black Butte Dam. Because this historic habitat is no longer accessible, chinook salmon are relegated to a small reach of the creek containing only marginal habitat. This makes these fish particularly vulnerable to the water management operations of the Corps and Reclamation. These Federal agencies, through the storage and release of flows, control the quantity and quality of the small amount of remaining habitat on Stony Creek.

The alteration of the natural hydrologic cycle due to upstream dam operations on Stony Creek has the potential to adversely affect all life stages of fall-run chinook salmon. Reservoir operations resulting in large scale flow fluctuations can cause adverse effects such as redd scouring or juvenile stranding. Extended periods of low flow releases can result in increased temperatures and reduced habitat availability.

Direct entrainment of juvenile fall-run chinook salmon may occur during operation of the North Canal and CHO Diversions. The diversion of water out of Stony Creek for consumptive purposes reduces flows below those diversions which results in increased water temperatures and reduced quality and quantity of essential habitat. The proposed fisheries monitoring study is expected to produce minor, short term impacts such as harassment and capture (with prompt release) of salmonids.

IV. CONCLUSION

Upon review of the effects of Lower Stony Creek water management, NMFS believes that the ingoing operations of upstream reservoirs and water diversions on Stony Creek adversely affect EFH of Pacific chinook salmon protected under MSFCMA.

V. EFH CONSERVATION RECOMMENDATIONS

As the habitat requirements of Central Valley fall/late fall-run chinook salmon within the action area are similar to those of the federally listed species addressed in the attached biological opinion, NMFS recommends that Reasonable and Prudent Measures Numbers 1, 2, and 3 and their respective Terms and Conditions listed in the Incidental Take Statement prepared for the Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon ESUs in the attached Biological Opinion, be adopted as EFH Conservation Recommendations. Additionally, the following conservation recommendations taken from the attached biological opinion also address project impacts to late-fall chinook salmon. These recommendations are provided as advisory measures.

> Reclamation and the Corps should support and promote habitat restoration activities in Lower Stony Creek, including the local land owner based efforts to restore healthy riparian habitat along the lower creek.
>
> Reclamation should, in it's pursuit of a solution to the fish passage/water supply problems at Red Bluff Diversion Dam, give a high priority to those alternatives which provide for all necessary water to be diverted from the main stem of the Sacramento River, thereby eliminating the need for CHO diversions from Stony Creek and reducing the irrigation water burden on the Stony Creek system.

VI. ACTION AGENCIES STATUTORY REQUIREMENTS

Section 305(b)(4)(B) of the Magnuson-Stevens Act and Federal regulations (50 CFR § 600.920) to implement the EFH provisions of the Magnuson-Stevens Act require federal action agencies to provide a detailed written response to NMFS, within 30 days of its receipt, responding to the EFH Conservation Recommendations. The response must include a description of measures adopted by the Agencies for avoiding, mitigating, or offsetting the impact of the project on Pacific salmon EFH. In the case of a response that is inconsistent with NMFS' recommendations, the Agencies must explain their reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(j)).

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